SECTION 087111 - DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Mechanical door hardware for the following:

a. Swinging doors.

2. Cylinders for door hardware specified in other Sections.
3. Electrified door hardware.

B. Products furnished, but not installed, under this Section include the products listed below. Coordinating and scheduling the purchase and delivery of these products remain requirements of this Section.

1. Pivots, and lock cylinders to be installed under other Sections.
2. Permanent lock cores to be installed by Owner.

C. Related Sections:
1. Division 08 "Hollow Metal Doors and Frames" for astragals provided as part of labeled fire-rated assemblies and for door silencers provided as part of hollow-metal frames].
2. Division 08 "Aluminum Frames" for door silencers provided as part of aluminum frames.
3. Division 08 "Flush Wood Doors" for astragals and integral intumescent seals provided as part of labeled fire-rated assemblies.
4. Division 08 "Overhead Coiling Doors" for door hardware provided as part of overhead door assemblies.
5. Division 01 Allowances.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Details of electrified door hardware.

C. Samples: For each exposed product and for each color and texture specified.

D. Other Action Submittals:

1. Door Hardware Schedule: Prepared by or under the supervision of Installer, detailing fabrication and assembly of door hardware, as well as installation procedures and diagrams. Coordinate final door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

    a. Format: Use same scheduling sequence and format and use same door numbers as in the Contract Documents.
    b. Content: Include the following information:

        1) Identification number, location, hand, fire rating, size, and material of each door and frame.
        2) Locations of each door hardware set, cross-referenced to Drawings on floor plans and to door and frame schedule.
        3) Complete designations, including name and manufacturer, type, style, function, size, quantity, function, and finish of each door hardware product.
        4) Description of electrified door hardware sequences of operation and interfaces with other building control systems.

2. Keying Schedule: Prepared by or under the supervision of Installer, detailing Owner's final keying instructions for locks.

1.3 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Supplier of products and an employer of workers trained and approved by product manufacturers and an Architectural Hardware Consultant who is available during the course of the Work to consult with Contractor, Architect, and Owner about door hardware and keying.

B. Architectural Hardware Consultant Qualifications: A person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and who is currently certified by DHI as follows:

1. For door hardware, an Architectural Hardware Consultant (AHC) who is also an Electrified Hardware Consultant (EHC) or Architectural Openings Consultant (AOC).

C. Source Limitations: Provide electrified door hardware from same manufacturer as mechanical door hardware, unless otherwise indicated.

D. Fire-Rated Door Assemblies: Where fire-rated door assemblies are indicated, provide door hardware rated for use in assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C, unless otherwise indicated.

E. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that meet requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.

1. Air Leakage Rate: Maximum air leakage of 0.3 cfm/sq. ft. at the tested pressure differential of 0.3-inch wg) of water.

F. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.

G. Means of Egress Doors: Latches do not require more than 15 lbf to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.

H. Accessibility Requirements: For door hardware on doors in an accessible route, comply with the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines.

1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf
2. Comply with the following maximum opening-force requirements:

    a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf applied perpendicular to door.
    b. Sliding or Folding Doors: 5 lbf applied parallel to door at latch.
    c. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.

3. Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than 1/2 inch high.
4. Adjust door closer sweep periods so that, from an open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches from the latch, measured to the leading edge of the door.

I. Keying Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination."

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Three years from date of Substantial Completion, unless otherwise indicated.

a. Electromagnetic Locks: Five years from date of Substantial Completion.
b. Exit Devices: Two years from date of Substantial Completion.
c. Manual Closers: 10 years from date of Substantial Completion.
d. Concealed Floor Closers: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

A. Provide door hardware for each door as shown on Drawings to comply with requirements in this Section.

1. Door Hardware Sets: Provide quantity, item, size, finish or color indicated.
2. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.

B. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of door hardware are indicated in Part 3 "Door Hardware Schedule" Article. Products are identified by descriptive titles corresponding to requirements specified in Part 2. Basis of design is denoted by asterisk (*).

2.2 HINGES

A. Hinges: BHMA A156.1. Provide template-produced hinges for hinges installed on hollow-metal doors and hollow-metal frames. Provide 4-1/2 inch by 4-1/2 inch size with non-removable pins for outswinging exterior doors unless otherwise specified. Provide non-rising pins elsewhere. Provide 5 inch by 4-1/2 inch hinges on doors over 3’0” wide. Provide number of hinges indicated but not less than three hinges per door leaf for doors 90 inches or less in height and one additional hinge for each 30 inches of additional height.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Bommer Industries
   b. Hager Companies*
   c. IVES Hardware; an Ingersoll-Rand company.
   d. McKinney Products Company; an ASSA ABLOY Group company.
   e. PBB, Inc.
   f. Stanley Commercial Hardware; Div. of the Stanley Works.

2.3 CONTINUOUS HINGES

A. Continuous Hinges: BHMA A156.26; minimum 0.120-inch- thick, hinge leaves with minimum overall width of 4 inches fabricated to full height of door and frame and to template screw locations; with components finished after milling and drilling are complete.

B. Continuous, Gear-Type Hinges: Extruded-aluminum, pinless, geared hinge leaves joined by a continuous extruded-aluminum channel cap; with concealed, self-lubricating thrust bearings.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Bommer Industries, Inc.*
   b. PBB
   c. Select Products Limited.
   d. Stanley Commercial Hardware; Div. of the Stanley Works.
   e. Zero International.

2.4 WIRELESS MORTISE LOCKS: ILS series locks by LENEL that provide smart card reader capability. Equivalent product by Onity is also acceptable.

2.5 MECHANICAL LOCKS AND LATCHES

A. Lock Functions: As indicated in door hardware schedule.

B. Lock Throw: Comply with testing requirements for length of bolts required for labeled fire doors, and as follows:

1. Bored Locks: Minimum 1/2-inch (13-mm) latchbolt throw.
2. Mortise Locks: Minimum 3/4-inch (19-mm) latchbolt throw.
3. Deadbolts: Minimum 1.25-inch (32-mm) bolt throw.

C. Lock Backset: 2-3/4 inches (70 mm), unless otherwise indicated.

D. Strikes: Provide manufacturer's standard strike for each lock bolt or latchbolt complying with requirements indicated for applicable lock or latch and with strike box and curved lip extended to protect frame; finished to match lock or latch.

1. Flat-Lip Strikes: For locks with three-piece antifriction latch bolts, as recommended by manufacturer.

E. Mortise Locks: BHMA A156.13; Operational Grade 1; stamped steel case with steel or brass parts; Series 1000.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. AUR lever design by YALE Manufacturing Company: An ASSA ABLOY Group.
   b. LRA lever design by DORMA; a DORMA Americas Company
   c. LO lever design by SARGENT Company; an ASSA ABLOY Group.
   d. 06A lever design by Schlage Lock; Division of Allegion.

2.6 EXIT DEVICES AND AUXILIARY ITEMS

A. Exit Devices and Auxiliary Items: BHMA A156.3.

1. Manufacturers: Subject to compliance with requirements, [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
   a. 9000 series by DORMA Architectural Hardware; A DORMA Americas Company
   b. 2000 series by Precision Hardware, Inc.; Division of Stanley Security Solutions.
   c. 8810 series by SARGENT Manufacturing Company; an ASSA ABLOY Group.
   d. 8801 series by Adams Rite Manufacturing.
   e. 99 series Von Duprin; an Ingersoll-Rand company.

B. Panic Exit Devices: Exit devices shall be type and function as listed in hardware sets. Where lever handle trim is specified, match lever trim on locksets. Furnish freewheeling lever trim as standard. Construct device touchbar, rail and cover assemblies of heavy gauge solid wrought materials for true architectural finishes. Provide cylinder dogging on all non rated devices. Furnish all devices with ¾" throw deadlocking latch bolts.

B. UL test in first paragraph below includes operational test of 100,000 cycles. BHMA A156.3 requires 500,000 cycles for Grade 1 and 250,000 cycles for Grade 2.

C. Fire Exit Devices: Devices complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire and panic protection, based on testing according to UL 305 and NFPA 252.

2.7 LOCK CYLINDERS

A. Lock Cylinders: Tumbler type, constructed from brass or bronze, stainless steel, or nickel silver.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Small format Interchangeable Core to match existing

B. Construction Cores: Provide construction cores that are replaceable by permanent cores. Provide keyed construction cores at all exterior doors and at other locations as required by the general contractor. Provide temporary plastic cores at all other locations. Provide 10 construction master keys.

2.8 KEYING

A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, Appendix A. Incorporate decisions made in keying conference.
1. Master Key System: Change keys and a master key operate cylinders.

B. Keys: Nickel silver

1. Stamping: Permanently inscribe each key with a visual key control number and include the following notation:

   a. Notation: "DO NOT DUPLICATE."

2. Quantity: In addition to one extra key blank for each lock, provide the following:

   a. Cylinder Change Keys: Three.
   b. Master Keys: Five.

2.9 KEY CONTROL SYSTEM

A. Key Control Cabinet: BHMA A156.5; metal cabinet with baked-enamel finish; containing key-holding hooks, labels, 2 sets of key tags with self-locking key holders, key-gathering envelopes, and temporary and permanent markers; with key capacity of 150 percent of the number of locks.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. American Key Boxes and Cabinets.
   a. HPC, Inc.
   b. Lund Equipment Co., Inc.
   c. MMF Industries
3. Portable Cabinet: Tray for mounting in file cabinet, equipped with key-holding panels, envelopes, and cross-index system.

B. Key Lock Boxes: Designed for storage of two keys, with tamper switches to connect to intrusion detection system.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. GE Security, Inc.
   b. HPC, Inc.
   c. Knox Company.

2.10 OPERATING TRIM

A. Operating Trim: BHMA A156.6:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. DORMA
   b. IVES Hardware; an Ingersoll-Rand Company.
   c. Rockwood Manufacturing Company.
   d. Trimco.

B. Flat Push Plates 1/8 inch (3.2 mm) thick, 4 inches wide by 16 inches high (102 mm wide by 406 mm high) with square corners and beveled edges; secured with exposed screws.

C. Push-Pull Plates: 1/8 inch (3.2 mm) thick, 3-1/2 inches wide by 15-3/4 inches high (89 mm wide by 400 mm high) with square corners, beveled edges, and raised integral lip; secured with exposed screws.

D. Straight Pull-Plate Door Pulls: 0.050-inch- (1.3-mm-) thick plate, 4 inches wide by 16 inches high (102 mm wide by 406 mm high) with square corners and beveled edges; pull with minimum clearance of 1-1/2 inches (38 mm) from face of door.

1. Type: 3/4-inch (19-mm) constant-diameter pull.
2. Mounting: Surface applied with concealed fasteners.
3. Overall Pull Length: 9 inches (229 mm).

2.11 ACCESSORIES FOR PAIRS OF DOORS

A. Coordinators: BHMA A156.3; consisting of active-leaf, hold-open lever and inactive-leaf release trigger; fabricated from steel with nylon-coated strike plates; with built-in, adjustable safety release; and with internal override.

B. Carry-Open Bars: BHMA A156.3; prevent the inactive leaf from opening before the active leaf; provide polished brass or bronze carry-open bars with strike plate for inactive leaves of pairs of doors unless automatic or self-latching bolts are used.

C. Flat Overlapping Astragals: BHMA A156.22; flat primed steel metal bar, surface mounted on face of door with screws; minimum 1/8 inch (3.2 mm) thick by 2 inches (51 mm) wide by full height of door.

2.12 SURFACE CLOSERS

A. Surface Closers: BHMA A156.4; Closers must have separate adjustments for latch speed, sweep speed and backcheck. Closers installed parallel arm to be supplied with heavy-duty rigid arms. Furnish non-handed closers with full plastic cover unless otherwise noted in the hardware sets. Where "IS" or "S-IS" arm is specified, if manufacturer does not offer this arm configuration, provide regular arm mounted closer with heavy duty overhead stop equal to a DORMA 900 Series. Provide brackets, drop plates, spacer blocks and accessories to ensure proper installation. Use manufacturer's chart for recommended sizes when adjusting closers. Provide one of the following heavy duty closers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. "4400 Series" Yale manufacturing
   b. "8916 Series", DORMA Architectural Hardware, A DORMA Americas Company
   c. "4040 Series", LCN Closers; an Ingersoll-Rand company.
   d. "350 Series", SARGENT Manufacturing Company; an ASSA ABLOY Group company.

B. Surface Closer with Cover: Grade 1; Modern Type with mechanism enclosed in cover.

1. Mounting: Parallel arm.
2. Type: Regular arm.
3. Backcheck: Adjustable, effective between 60 and 85 degrees of door opening.
4. Cover Material: Aluminum.
5. Closing Power Adjustment: At least 35 percent more than minimum tested value.

2.13 OVERHEAD CONCEALED CLOSERS AND FLOOR CLOSER

A. Overhead Concealed Closers, BHMA A156.4: Provide cam and roller design concealed closers. Invert closers to install closer body in the frame head. Size closers properly according to application. Provide barrier free closers at handicapped guest rooms. Provide closers with adjustable cushioned stop.

2.14 MECHANICAL STOPS AND HOLDERS

A. Wall- and Floor-Mounted Stops: BHMA A156.16; polished cast brass, bronze, or aluminum base metal.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Architectural Builders Hardware Mfg., Inc.
b. Hager Companies.
c. IVES Hardware; an Ingersoll-Rand company.
d. Rockwood Manufacturing Company.
e. Trimco.*

B. Dome-Type Floor Stop: Grade 1 with minimum 1-inch- (25-mm-) high bumper for doors without threshold and 1-3/8-inch- (35-mm-) high bumper for doors with threshold; provide with extruded aluminum riser for carpet installations.

C. Wall Bumpers: Grade 1; with rubber bumper; 2-1/2-inch (64-mm) diameter, minimum 3/4-inch (19-mm) projection from wall; with backplate for concealed fastener installation; with convex bumper configuration.

2.15 DOOR GASKETING

A. Door Gasketing: BHMA A156.22; air leakage not to exceed 0.50 cfm per foot (0.000774 cu. m/s per m) of crack length for gasketing other than for smoke control, as tested according to ASTM E 283; with resilient or flexible seal strips that are easily replaceable and readily available from stocks maintained by manufacturer.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. National Guard Products.
b. Pemko Manufacturing Co.; an ASSA ABLOY Group company.
c. Reese Enterprises, Inc.
d. Zero International.*

B. Adhesive-Backed Perimeter Gasketing: Vinyl bulb gasket material applied to frame rabbet with self-adhesive.

C. Door Sweeps: Nylon brush gasket material held in place by flat aluminum housing or flange; surface mounted to face of door with screws.

2.16 THRESHOLDS

A. Thresholds: BHMA A156.21; fabricated to full width of opening indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. National Guard Products.
   b. Pemko Manufacturing Co.; an ASSA ABLOY Group company.
   c. Reese Enterprises, Inc.
   d. Zero International.*

B. Compressing-Top Thresholds: Metal member with compressible vinyl seal on top of threshold that seals against bottom of door; and base metal of stainless steel.

C. Saddle Thresholds:

1. Type: Fluted top.
2. Base Metal: Stainless steel.

D. Half-Saddle Thresholds: Fluted-top metal member; and base metal of aluminum.

2.17 METAL PROTECTIVE TRIM UNITS

A. Metal Protective Trim Units: BHMA A156.6; fabricated from 0.050-inch- (1.3-mm-) thick stainless steel; with manufacturer's standard machine or self-tapping screw fasteners.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Don-Jo Mfg., Inc.
   b. IVES Hardware; an Ingersoll-Rand company.
   c. Rockwood Manufacturing Company.
   d. Trimco.

B. Kick Plates8 inches high by door width with allowance for frame stops.

2.18 AUXILIARY DOOR HARDWARE

A. Auxiliary Hardware: BHMA A156.16.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Don-Jo Mfg., Inc.
   b. IVES Hardware; an Ingersoll-Rand company.
   c. Rockwood Manufacturing Company.
   d. Trimco.

2.19 FABRICATION

A. Manufacturer's Nameplate: Do not provide products that have manufacturer's name or trade name displayed in a visible location except in conjunction with required fire-rated labels and as otherwise approved by Architect.

1. Manufacturer's identification is permitted on rim of lock cylinders only.

B. Base Metals: Produce door hardware units of base metal indicated, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18.

C. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood, and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated.

1. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching the door hardware. Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.
2. Fire-Rated Applications:
   a. Wood or Machine Screws: For the following:
      1) Hinges mortised to doors or frames; use threaded-to-the-head wood screws for wood doors and frames.
      2) Strike plates to frames.
      3) Closers to doors and frames.

b. Steel Through Bolts: For the following unless door blocking is provided:
   1) Closers to doors and frames.
   2) Surface-mounted exit devices.

3. Spacers or Sex Bolts: For through bolting of hollow-metal doors.
4. Fasteners for Wood Doors: Comply with requirements in DHI WDHS.2, "Recommended Fasteners for Wood Doors."
5. Gasketing Fasteners: Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

2.20 FINISHES

A. Provide Satin Chrome/Stainless Steel unless otherwise noted.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

D. Unlacquered Brass finish on each product is subject to final approval by architect. Provide samples at architect's request.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Steel Doors and Frames: For surface applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.

B. Wood Doors: Comply with DHI WDHS.5 "Recommended Hardware Reinforcement Locations for Mineral Core Wood Flush Doors."

C. Mounting Heights: Mount door hardware units at heights to comply with the following unless otherwise indicated or required to comply with governing regulations.

1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
2. Custom Steel Doors and Frames: HMMA 831.
3. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."

D. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work. Do not install surface-mounted items until finishes have been completed on substrates involved.

1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

E. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than the number recommended by manufacturer for application indicated or one hinge for every 30 inches of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.

F. Lock Cylinders: Install construction cores to secure building and areas during construction period.

1. Replace construction cores with permanent cores as indicated in keying schedule.
2. Furnish permanent cores to Owner for installation.

G. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.

H. Thresholds: Set thresholds for exterior doors and other doors indicated in full bed of sealant complying with requirements specified in Section 079200 "Joint Sealants."

I. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they will impede traffic.

J. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.

K. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.

L. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

M. Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

3.2 HARDWARE SCHEDULE

HW-01
Doors: ST1-C, ST2-C

Each pair to receive:

2	Continuous hinges	FM83HD	628	Bommer
2	Exit Devices	99EO	630	VonDuprin
2	Closers	UNI-4400	689	Yale
1	Keyed Removable Mullion	KR4954	SP28	VonDuprin
1	Rim or mortise cylinders	as required	US26D	Yale
2	Kick Plates	K0050 8"x34"	630	Trimco
1	Weather strip	328	AA	Zero
1	Door Sweep	39A	A	Zero
1	Threshold	655A	A	Zero
1	Horn	914	Red	RCI
2	Door position switches	MC-4	A	DORMA

NOTE: Provide signs that indicate Emergency Exit only. Alarm will sound.
Horn to be hard wired to work with security system.

HW-02
Doors: ST1-A, ST2-A, ST1-B, ST2-B

Each pair to receive:

6	Hinges	BB1279 4 1/2" x 4 1/2"	US26D	Hager
2	Exit Device	99L-F-BE	630	Von Duprin
2	Closer	4400-REG	689	Yale
1	Keyed Removable Mullion	KR9954	SP28	Von Duprin
1	Rim or mortise cylinder	as req.	US26D	Yale
1	Electro-Magnetic Door HO	SEM 7850 (by extensions as req.)	AL	LCN
1	Electro-Magnetic Door HO	SEM 7820 (by floor mounted.)	AL	LCN
2	Kick Plate	K0050 8"x34"	630	Trimco
1	Perimeter seal	488S	Bk	Zero

NOTE: Install floor mounted hold open so that it is not a trip hazard.

HW-03
Door: 136A

Each pair to receive:

6	Hinges	BB1279 4 1/2" x 4 1/2"	US26D	Hager
2	Power transfers	PT1000	US32D	ABH
2	Electric exit devices	55-56-8810	US32D	Sargent
2	Pull bars	1191-5 x type E mount	630	Trimco
2	Closers	UNI-4400 (by drop plates as req)	689	Yale
1	Keyed Removable Mullion	L980S	28	Sargent
1	Rim or mortise cylinder	as required	US26D	Yale
2	Kick Plates	K0050 8"x34"	630	Trimco
1	Perimeter seal	488S-Bk	Bk	Zero
1		Power supply by security contractor		
1		Card reader by security contractor		

HW-04
Doors: G119A, 138A

Each to receive:

3	Hinges	BB1279 4 1/2" x 4 1/2"	US26D	Hager
1	Wireless lock	ILS	626	Lenel
1	Closer	4400-REG	689	Yale
1	Overhead stop	597	EN	Sargent
1	Kick Plate	K0050 8"x34"	630	Trimco
3	Silencers	1229A		Trimco

HW-05
Doors: G133A, G133B, G120A

Each to receive:

3	Hinges	BB1279 4 1/2" x 4 1/2"	US26D	Hager
1	Wireless lock	ILS	626	Lenel
1	Closer	4400-REG	689	Yale
1	Kick Plate	K0050 8"x34	630	Trimco
1	Wall/Floor stop	1270CV/1211 as req.	630/626	Trimco
3	Silencers	1229A		Trimco

HW-06
Door: G119B

Each to receive:

3	Hinges	BB1279 4 1/2" x 4 1/2"	US26D	Hager
1	Wireless lock	ILS	626	Lenel
1	Closer	UNI-4400	689	Yale
1	Kick Plate	K0050 8"x34"	630	Trimco
3	Silencers	1229A		Trimco

HW-07
Doors; G115A, 132A

Each to receive:

3	Hinges	BB1279 4 1/2" x 4 1/2"	US26D	Hager
1	Wireless lock	ILS	626	Lenel
1	Closer	UNI-4400	689	Yale
1	Kick Plate	K0050 8"x34"	630	Trimco
3	Silencers	1229A		Trimco

HW-08
Door: 138B

Each to receive:

3	Hinges	BB1279 4 1/2" x 4 1/2"	US26D	Hager
1	Wireless lock	ILS	626	Lenel
1	Closer	4400-REG	689	Yale
1	Kick Plate	K0050 8"x34"	630	Trimco
1	Floor stop	1211	626	Trimco
3	Silencers	1229A		Trimco

HW-09
Door: 142A

Each to receive:

3	Hinges	BB1279 4 1/2" x 4 1/2"	US26D	Hager
1	Wireless lock	ILS	626	Lenel
1	Closer	4400-REG	689	Yale
1	Kick Plate	K0050 8"x34"	630	Trimco
1	Wall stop	1270CV	630	Trimco
3	Silencers	1229A		Trimco

HW-10
Doors: 151A, 137A, 147A

Each to receive:

3	Hinges	BB1279 4 1/2" x 4 1/2"	US26D	Hager
1	Passage	8801FL	626	Yale
1	Wall stop	1270CV	630	Trimco
3	Silencers	1229A		Trimco

HW-11
Doors: G125A, G128A, 140A, 141A, 144A, 145A, 146A

Each to receive:

3	Hinges	BB1279 4 1/2" x 4 1/2"	US26D	Hager
1	Wireless lock	ILS	626	Lenel
1	Wall stop	1270CV	630	Trimco
3	Silencers	1229A		Trimco

HW-12
Door: 136B

Each to receive:

3	Hinges	BB1279 4 1/2" x 4 1/2"	US26D	Hager
1	Power transfer	PT1000	US26D	ABH
1	Electric exit devices	55-56-8810	US32D	Sargent
1	Pull bar	1191-5 x type E mount	630	Trimco
1	Closer	UNI-4400 (by drop plates as req)	689	Yale
1	Perimeter seal	488S-Bk	Bk	Zero
1		Power supply by security contractor		
1		Card reader by security contractor		

HW-13
Door: 139A

Each to receive:

3	Hinges	BB1279 4 1/2" x 4 1/2"	US26D	Hager
1	Privacy with Indicator	AUR 8864FL	626	Yale
1	Closer	4400-REG	689	Yale
1	Kick Plate	K0050 8"x34"	630	Trimco
1	Wall stop	1270CV	630	Trimco
1	Perimeter seal	488S-Bk	Bk	Zero

HW-14
Doors: G111A, G112A, 130A

Each to receive:

3	Hinges	BB1168 4 1/2" x 4 1/2"	US26D	Hager
1	Push Plate	1001-3	630	Trimco
1	Pull Plate	1013-3B	630	Trimco
1	Closer	PR4400	689	Yale
1	Kick Plates	K0050 8"x34"	630	Trimco
1	Wall stop	1270CV	630	Trimco
1	Perimeter seal	488S-Bk	Bk	Zero

HW-15
Door: 143A

Each to receive:

3	Hinges	BB1279 4 1/2" x 4 1/2"	US26D	Hager
1	Wireless lock	ILS	626	Lenel
1	Closer	UNI-4400	689	Yale
1	Kick Plate	K0050 8"x34"	630	Trimco
3	Silencers	1229A		Trimco

HW-16
Doors: G117B

Each to receive:

3	Hinges	BB1279 4 1/2" x 4 1/2"	US26D	Hager
1	Passage	8801FL	626	Yale
1	Closer	UNI-4400	689	Yale
1	Kick Plate	K0050 8"x34"	630	Trimco
3	Silencers	1229A		Trimco

NOTE: Verify that the existing frame is prepped for three hinges and an ANSI strike.

HW-17
Door: G134A

Each to receive:

3	Hinges	BB1279 4 1/2" x 4 1/2" NRP	US26D	Hager
1	Wireless lock	ILS	626	Lenel
1	Closer	UNI-4400	689	Yale
1	Kick Plate	K0050 8"x34"	630	Trimco
3	Silencers	1229A		Trimco

NOTE: Verify that the existing frame is prepped for three hinges and an ANSI strike.

HW-18
Sliding Barn Doors: G132A

Each pair to receive:

1 set	Sliding track & hardware	Agile 150 x Syncro x wall mount x 1 ¾ wood doors.		DORMA
1	Entrance lock	2001 SDL-3 x appropriate strike	626	Accurate
1	Flush pull	24SC x cylinder	626	Accurate
1	Flush pull	24ST x thumbturn	626	Accurate
1	Mortise cylinder	as required	626	Yale
2	Pull handles	1193-2 x type N mount	630	Trimco

NOTE: Mount pull handles so that they do not interfere with the entry lock.

ALUMINUM

HW-AL1
Door: G131A

Each pair to receive:

2	Continuous hinges	FM83HD- EPT	628	Bommer
2	Power transfers	EPT-10	630	VonDuprin
1	Exit Device	EL99NL-OP-RX	630	VonDuprin
1	Exit Device	EL-99EO-RX	630	VonDuprin
1	Automatic operator	3931	689	Yale
1	Closer	UNIJ-4400 (by back plates as req)	689	Yale
1	Keyed Removable Mullion	KR4954	SP28	VonDuprin
2	Rim or mortise cylinder	as required	US26D	Yale
2	Pull bars	1191-5 x type E mount	630	Trimco
2	Actuator push pads	4 X4 -3	US32D	Wikk
1	Threshold	545A	A	Zero
2	Door position switches	MC-4	A	DORMA
1	Power supply	PS914-2RS		VonDuprin
1		Seals by door manufacturer		
1		Card reader by security contractor		

HW-AL2
Door: G131B

Each pair to receive:

2	Continuous hinges	FM83HD- EPT	628	Bommer
2	Power transfers	EPT-10	630	VonDuprin
1	Exit Device	EL99NL-OP-RX	630	VonDuprin
1	Exit Device	EL-99EO-RX	630	VonDuprin
2	Closers	UNIJ-4400 (by back plates as req)	689	Yale
1	Keyed Removable Mullion	KR4954	SP28	VonDuprin
2	Rim or mortise cylinder	as required	US26D	Yale
2	Pull bars	1191-5 x type E mount	630	Trimco
1	Threshold	545A	A	Zero
2	Door position switches	MC-4	A	DORMA
1	Power supply	PS914-2RS		VonDuprin
1		Seals by door manufacturer		
1		Card reader by security contractor		

HW-AL3
Door: G131C

Each pair to receive:

2	Continuous hinges	FM83HD	628	Bommer
2	Push Pull Bar sets	1746 x type G mount	630	Trimco
1	Automatic operator	3931	689	Yale
1	Closer	UNIJ-4400 (by back plates as req)	689	Yale
2	Actuator push pads	4 X4 -3 Actuator	630	Wikk

HW-AL4
Door: G131D

Each pair to receive:

2	Continuous hinges	FM83HD-628	628	Bommer
2	Push Pull Bar sets	1746 x type G mount	630	Trimco
2	Closers	UNIJ-4400 (by back plates as req)	689	Yale
1	Seals by door manufacturer			

HW-AL5
Doors: G107A, G107B

Each to receive:

3	Hinges	BB1279 4 1/2" x 4 1/2" US26D	US26D	Hager
1	Power transfer	4612	US26D	Adams Rite
1	Electric exit device	8801-SE-REX	US32D	Adams Rite
1	Pull bar	1191-5 x type E mount	630	Trimco
1	Closer	UNIJ-4400 (by back plates as req)	689	Yale
1	Power supply	PS-SE		Adams Rite
1		Seals by door manufacturer		
1		Card reader by security contractor		

HW-AL6
Doors: 112A, 114A, 115A, 116A, 117A, 118A, 119A, 122A, 123A, 123B

Each to receive:

3	Hinges	BB1279 4 1/2" x 4 1/2"	US26D	Hager
1	Wireless lock	ILS	626	Lenel
1	Closer	4400-REG (by drop plates as req)	689	Yale
1	Wall/floor stop	1270CV/1211 as required.	630/626	Trimco
1	Seals by door manufacturer			

HW-AL7
Door: 143B

Each to receive:

3	Hinges	BB1279 4 1/2" x 4 1/2"	US26D	Hager
1	Wireless lock	ILS	626	Lenel
1	Closer	UNIJ-4400 (by back plates as req)	689	Yale
1	Wall/floor stop	1270CV/1211 as required.	630/626	Trimco
1	Seals by door manufacturer			

END OF SECTION

SECTION 23 05 15 – VARIABLE FREQUENCY SPEED CONTROLLERS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

A. The requirements of the General Conditions, Special Conditions and Section 15010 [23 00 00], Mechanical General, apply to all work specified in this section.

1.2 COORDINATION:

A. The speed controllers of one manufacturer have been used as the basis of design. Any modifications that result from the use of any other units shall be coordinated with all trades. Any modifications shall be performed without incurring any additional cost to the contract.

1.3 ACCEPTABLE MANUFACTURERS:

A. Variable frequency speed controllers manufactured by ASEA-Brown-Bovari (ABB), Danfoss or Cutler Hammer will be acceptable.
B. Warranty: Provide full factory warranty for 36 months.

PART 2 – PRODUCTS

2.1 DESCRIPTION:

A. The variable frequency speed controllers shall be provided in a NEMA 1 enclosure for individual partition or fabricated support installation.

B. The speed controllers shall be of the variable voltage input type or pulse width modulation type.

C. If fabricated supports are used to mount speed controllers, they shall be designed to support the full weight of the controller plus any additional force anticipated to be applied during installation, maintenance or incidental contact. If controllers are partition mounted, structural supports shall be incorporated in the partition framing to comply with the same criteria.

D. Fused input shall utilize standard I squared T type fuses.

E. Inverters shall have UL or ETL approval.

F. Each variable frequency power and logic unit shall be solid state. The unit shall transform input power into frequency and voltage controlled 3 phase output power suitable to provide positive speed and torque control to air handling unit motors. The speed control shall be stepless throughout the speed range under variable torque load on a continuous basis. The adjustable frequency control/motor combination shall have a power factor of 0.95 or better.

G. Each variable frequency speed controller shall superimpose no electrical line noise on the line side of the electrical service to the controller. Electrical isolation fitters on the line side of the controller are to be included to achieve this result, if required by the characteristics of the speed controller.

H. The speed controller and the speed controller/controlled motor combination shall be certified to be compatible in writing by both the controller manufacturer and the motor manufacturer.

I. The controller/controlled motor combination shall cause no airborne or structure-borne noise to be produced which could cause the occupied areas below the equipment room to experience noise levels exceeding NC40.

J. Factory installed disconnecting means shall be provided on the power to the controller.

2.2 SELF PROTECTION AND RELIABILITY FEATURES:

A. Each controller shall limit output current to 110% of the inverter rating.

B. Each controller shall safely limit the output current in under 50 micro-seconds due to phase short circuits or severe overload conditions.

C. To protect the controller due to non-momentary power or phase loss, under-voltage trip shall activate automatically when line voltage drops 15% below rated input voltage.

D. To protect the inverter due to voltage levels in excess of its rating, over-voltage trip shall activate automatically when the DC bus in the controller exceeds 1000 VDC.

E. Over-temperature trip shall be required to protect the inverter from elevated temperatures in excess of its rating.

F. The controller shall automatically restart from a trip condition resulting from over-current, under-voltage, over-voltage or over-temperature upon removal or correction of the causative condition.

G. For indications of conditions described in items A through E and to show power on, zero speed, and enabled shall be provided in the front panel of the unit.

H. Current and voltage signals shall be isolated from the logic circuitry.

I. Drive logic shall be microprocessor based.

J. In the event of a power loss, the control shall shut down without component failure. Upon return of power the system shall be designed to automatically return to normal operation if the unit is enabled.

K. In the event of a phase short circuit, the control shall be designed to shut down safely without component failure.

L. In the event that an input or output power contactor is opened or closed while the control is activated, no damage to the control shall result.

M. The control shall operate without a motor or any other equipment connected to the inverter.

2.3 OTHER FEATURES:

A. Controller shall be capable of tolerating the following ambient temperatures:

1. Operating: 0 to 40 degrees C.

2. Storage: -20 to 60 degrees C.

B. The output frequency shall not vary with load nor with any input frequency variations. Output frequency will not vary with $\pm$10% input voltage changes.

C. A zero to five volt DC signal shall be provided for speed indicator meter. Provide a 0-100% speed meter compatible with the inverter reference signal mounted on the front panel of the controller.

D. The controller shall be started or stopped by a contact closure.

E. Power supply (115 volt ac) shall be available on the customer connection board when power has been applied.

F. The controller shall accelerate or decelerate in response to a 4-20 mA signal from the EMS.

G. Full unit bypass and accelerate-stop-decelerate switch shall be mounted on door of unit. The switch shall accelerate, decelerate or stop the controller independent of the control panel. Full bypass operation shall disable the controller and allow air unit operation.

I. Provide a 0-100% speed meter compatible with the inverter reference signal to be mounted in the door of the control panel provided under Division 15 [23].

PART 3 – EXECUTION

3.1 INSTALLATION AND START UP:

A. The controller manufacturer shall provide start-up supervision, in conjunction with the control contractor, as required to place the inverter and control system in proper operation and instruct the Owner.

B. Provide a spare parts kit for the inverter as recommended by the manufacturer.

END OF SECTION 23 05 15

SECTION 23 05 93 - TESTING, ADJUSTING, AND BALANCING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes testing, adjusting, and balancing HVAC systems to produce design objectives, including the following:

1. Balancing airflow and water flow within distribution systems, including submains, branches, and terminals, to indicated quantities according to specified tolerances.
2. Adjusting total HVAC systems to provide indicated quantities.
3. Measuring electrical performance of HVAC equipment.
4. Setting quantitative performance of HVAC equipment.
5. Verifying that automatic control devices are functioning properly.
6. Measuring sound and vibration.
7. Reporting results of activities and procedures specified in this Section.

1.2 DEFINITIONS

A. AABC: Associated Air Balance Council.

B. AMCA: Air Movement and Control Association.

C. NEBB: National Environmental Balancing Bureau.

D. SMACNA: Sheet Metal and Air Conditioning Contractors' National Association.

1.3 SUBMITTALS

A. Strategies and Procedures Plan: Testing, adjusting, and balancing strategies and step-by-step procedures. Include a complete set of report forms intended for use on this Project.

B. Certified Testing, Adjusting, and Balancing Reports: Prepared on approved forms certified by the testing, adjusting, and balancing Agent.

1.4 QUALITY ASSURANCE

A. Agent Qualifications: Engage a testing, adjusting, and balancing agent certified by AABC or NEBB.

B. Certification of Testing, Adjusting, and Balancing Reports: Certify testing, adjusting, and balancing field data reports. This certification includes the following:

1. Review field data reports to validate accuracy of data and to prepare certified testing, adjusting, and balancing reports.
2. Certify that testing, adjusting, and balancing team complied with approved testing, adjusting, and balancing plan and procedures specified and referenced in this Specification.

C. Testing, Adjusting, and Balancing Reports: Use standard forms from AABC's "National Standards for Testing, Adjusting, and Balancing." or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems."

D. Instrumentation Type, Quantity, and Accuracy: As described in AABC national standards or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems," Section II, "Required Instrumentation for NEBB Certification."

E. Instrumentation Calibration: Calibrate instruments at least every six months or more frequently if required by the instrument manufacturer.

1.5 COORDINATION

A. Coordinate efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist testing, adjusting, and balancing activities.

B. Perform testing, adjusting, and balancing after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

1.6 WARRANTY

A. National Project Performance Guarantee: Provide a guarantee on AABC'S "National Standards" forms stating that AABC will assist in completing the requirements of the Contract Documents if the testing, adjusting, and balancing Agent fails to comply with the Contract Documents. Guarantee includes the following provisions:

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the Contract Documents to become familiar with project requirements and to discover conditions in systems' designs that may preclude proper testing, adjusting, and balancing of systems and equipment.

1. Verify that balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.

B. Examine approved submittal data of HVAC systems and equipment.

C. Examine Project Record Documents described in Division 1 Section "Project Record Documents."

D. Examine equipment performance data, including fan and pump curves. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system. Calculate system effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from those presented when equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," Sections 7 through 10; or in SMACNA's "HVAC Systems--Duct Design," Sections 5 and 6. Compare this data with design data and installed conditions.

E. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Specification Sections have been performed.

F. Examine system and equipment test reports.

G. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.

H. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.

I. Examine air-handling equipment to ensure clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

J. Examine plenum ceilings, utilized for supply air, to verify that they are airtight. Verify that pipe penetrations and other holes are sealed.

K. Examine equipment for installation and for properly operating safety interlocks and controls.

L. Examine automatic temperature system components to verify the following:

1. Dampers, valves, and other controlled devices operate by the intended controller.
2. Dampers and valves are in the position indicated by the controller.
3. Thermostats and humidistats are located to avoid adverse effects of sunlight, drafts, and cold walls.
4. Sequence of operation for control modes is according to the Contract Documents.
5. Changes in conditions. Record default set points if different from design values.
6. Interlocked systems are operating.
7. Changeover from heating to cooling mode occurs according to design values.

M. Report deficiencies discovered before and during performance of testing, adjusting, and balancing procedures.

3.2 PREPARATION

A. Prepare a testing, adjusting, and balancing plan that includes strategies and step-by-step procedures.

B. Complete system readiness checks and prepare system readiness reports. Verify the following:

1. Permanent electrical power wiring is complete.
2. Automatic temperature-control systems are operational.
3. Equipment and duct access doors are securely closed.
4. Balance, smoke, and fire dampers are open.
5. Isolating and balancing valves are open and control valves are operational.
6. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
7. Windows and doors can be closed so design conditions for system operations can be met.

3.3 TESTING AND BALANCING PROCEDURES

A. Perform preliminary test and balance of existing chilled water, condenser water and hot water systems. This testing shall be performed at the commencement of the project and shall be coordinated with owner. Provide report of existing conditions to include the following:
1. Maximum available flow in GPM
2. Static pressure differential at pump at maximum available flow.

B. Perform testing and balancing procedures on each system according to procedures contained in AABC national standards. or NEBB's "Procedural Standards for Testing,

Adjusting, and Balancing of Environmental Systems." or SMACNA's "HVAC Systems--Testing, Adjusting, and Balancing."

C. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to the insulation Specifications for this Project.

D. Mark equipment settings with paint or other suitable, permanent identification material, including damper-control positions, valve indicators, fan-speed-control levers, and similar controls and devices, to show final settings.

3.4 TOLERANCES

A. Set HVAC system airflow and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans: Plus 5 to plus 10 percent.
2. Air Outlets and Inlets: 0 to minus 10 percent.

3.5 REPORTS

A. Status Reports: As Work progresses, prepare reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

B. Final Report: Typewritten, or computer printout in letter-quality font, on standard bond paper, bound in three-ring, loose-leaf binder, and tabulated and divided into sections by tested and balanced systems.

1. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing agent.
2. Include a list of instruments used for procedures, along with proof of calibration.
3. Final Report Contents: In addition to certified field report data, include the following:
    a. Fan curves.
    b. Manufacturers' test data.
    c. Field quality-control test reports prepared by system and equipment installers.
    d. Other information relative to equipment performance, but do not include approved Shop Drawings and Product Data.

4. General Report Data: In addition to form titles and entries, include the following data in the final report, as applicable:

a. Title page.
b. Name and address of testing, adjusting, and balancing Agent.
c. Project name.
d. Project location.
e. Architect's name and address.
f. Engineer's name and address.
g. Contractor's name and address.
h. Report date.
i. Signature of testing, adjusting, and balancing Agent who certifies the report.
j. Summary of contents, including the following:

    1) Design versus final performance.
    2) Notable characteristics of systems.
    3) Description of system operation sequence if it varies from the Contract Documents.

k. Nomenclature sheets for each item of equipment.
l. Data for terminal units, including manufacturer, type size, and fittings.
m. Notes to explain why certain final data in the body of reports vary from design values.
n. Test conditions for fans and pump performance forms, including the following:

    1) Settings for outside-, return-, and exhaust-air dampers.
    2) Conditions of filters.
    3) Cooling coil, wet- and dry-bulb conditions.
    4) Fan drive settings, including settings and percentage of maximum pitch diameter.
    5) Settings for supply-air, static-pressure controller.
    6) Other system operating conditions that affect performance.

5. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present with single-line diagrams and include the following:

    a. Quantities of outside, supply, return, and exhaust airflows.
    b. Duct, outlet, and inlet sizes.

END OF SECTION 23 05 93

SECTION 23 09 00 – INSTRUMENTATION AND CONTROL FOR HVAC

PART 1 - GENERAL

1.01 OVERVIEW

This document contains the specification and input/output summaries for a Building Automation System (BAS) for:

Kennesaw State University – Sturgis Library Renovations

The system shall provide the Direct Digital Control (DDC), Energy Management and Building Automation System (BAS) for the air conditioning, heating and ventilating and integrated lighting controls systems and shall interface with other microprocessor based building subsystems as detailed in the Input/Output Summaries and as specified herein. All damper and valve actuators shall be electronic.

The proposed system shall interface with any existing Energy Management and Building Automation System (BAS) components which are to remain. All modifications to the existing system and building graphics to incorporate the work described under this project specification shall be included. This shall include updating the system map, building floor plans and applicable indexes. The proposed system should be the newest version of web based software that is available. Upon completion of this contract all functions specified herein shall be operational.

The Building Automation System shall be as herein specified and as manufactured and furnished by Andover or Automated Logic.

The control system shall consist of a high-speed, peer-to-peer network of DDC controllers and a web-based operator interface. Depict each mechanical system and building floor plan by a point-and-click graphic. A web server with a network interface card shall gather data from this system and generate web pages accessible through a conventional web browser on each PC connected to the network. Operators shall be able to perform all normal operator functions through the web browser interface.

The system shall directly control HVAC equipment as specified in Section 23 0900 Sequences of Operation. Each zone controller shall provide occupied and unoccupied modes of operation by individual zone. Furnish energy conservation features such as optimal start and stop, night setback, request-based logic, and demand level adjustment of setpoints as specified in the Points List.

System shall use the BACnet protocol for communication to the operator workstation or web server and for communication between control modules and networked lighting panels. Schedules, setpoints, trends, and alarms specified under Sequence of Operation, shall be BACnet objects.

1.02 INSTRUCTIONS TO BIDDERS

The system specified in this document shall be native BACnet architecture providing full operator access via the Internet or Local Area Network utilizing only a browser for full operator access and control through a thin-client architecture. The requirements are described in this specification. No deviations from this specification are acceptable. All Graphics and software shall appear seamless with the existing Building Automation System.

The control system shall consist of a high-speed, peer-to-peer network of DDC controllers and a web-based operator interface. Depict each mechanical system and building floor plan by a point-and-click graphic. A web server with a network interface card shall gather data from this system and generate web pages accessible through a conventional web browser on each PC connected to the network. Operators shall be able to perform all operator functions through the web browser interface and there shall be unlimited simultaneous users included in this bid.

All Bidders shall submit a Technical Compliance Statement stating full and complete compliance with the Technical Specification or any and all deviations or exceptions to the Technical Specification. Failure to supply this required Technical Compliance Statement with the Bid shall render the Bidder's Bid Non-Responsive.

Also, Bidder is cautioned that the Owner reserves the right to reject any Bidder's bid which, in the Owners sole judgment, takes meaningful deviation or exception to the Technical Specification in the Technical Compliance Statement.

1.03 SCOPE OF WORK

A. Contractor's Responsibilities
The Contractor shall furnish and install all necessary software and hardware, wiring, and computing equipment in compliance with this specification. Any variances from this specification or related documentation shall be submitted in writing at the time of bid.

B. System Requirements
1. Standard Material/Products. All material and equipment used shall be standard components, regularly manufactured and available, and not custom designed especially for this project
2. Modular Design. The system architecture shall be fully modular permitting expansion of application software, system peripherals, and field hardware.
3. Performance. The system, upon completion of the installation and prior to acceptance of the project, shall perform all operating functions as detailed in this specification.

C. Equipment
1. System Hardware
The Contractor shall provide the following:
a. PC’s, PDA’s, server(s), routers, modems and control modules as specified.
b. All sensing devices, relays, switches, indicating devices, and transducers required to perform the functions as listed in the sequence of operations.

c. All monitoring and control wiring.

2. System Software
   a. The Controls Contractor shall provide all software identified in Part 2 of this specification, including the BAS Server, fully configured database, graphics, reports, alarm/events. The Graphical User Interface (GUI) shall be completely Web based as specified herein and shall be manufactured by the same company as the DDC controllers. No exceptions.
   b. The system as specified shall monitor, control and calculate all the points and perform all the functions as listed in I/O Point Summary Schedule attached as Part 6 I/O Point Summary to this specification.

D. Codes and Regulations
   1. Standards Authority. All electrical equipment and material, and its installation, shall conform to the current requirements of the following authorities:
      a. Occupational Safety and Health Act (OSHA)
      b. National Electric Code (NEC)
      c. National Fire Code
      d. International Mechanical Code
      e. International Building Code
      f. International Plumbing Code
   2. Product Applicable Standards. All distributed, standalone and unitary controllers supplied shall be in compliance with the following listings and standards:
      a. UL916 for Open Energy Management (for U.S. and Canada)
      b. FCC Part 15, Sub-Part B, Class A
      c. CE Electro Magnetic Compatibility
   3. Manufacturer's Quality System. The control system manufacturer shall be ISO9001 listed for design and manufacture of environmental control systems for precise control and comfort, indoor air quality, HVAC plant operation, energy savings and preventative maintenance. ISO Certification shall be by a registrar that is accredited by an internationally recognized organization such as RAB. Copy of ISO9001 certificate shall be submitted with bid.
   4. Conflict of Codes. Where two or more codes conflict, the most restrictive shall apply. Nothing in this specification or related documentation shall be construed to permit work not conforming to applicable codes.

1.04 GENERAL CONDITIONS

A. Changes in Scope of Work
   Any changes in the scope of work must be authorized by a written Change Order.

B. Correction of Work
   1. Contractor's Responsibility. The Contractor shall promptly correct all work found defective or failing to conform to the Contract Documents. The Contractor shall bear all cost of correcting such work.
   2. During Warranty. If, within the warranty period required by the Contract Documents, any of the work is found to be defective or not in accordance with the Contract Documents, the Contractor shall correct it promptly after receipt of a written notice to do so.

C. Coordination of Work During Construction
   1. The Contractor shall coordinate any necessary changes in work scheduling to minimize disruption.
      a. The Contractor shall protect the installed works by other trades.
      b. The Contractor shall coordinate with other trades.
      c. The Contractor shall repair any damage caused by his work to building(s) and equipment at no additional cost to the owner.

D. Warranty
   The Contractor shall warrant, from the date of final acceptance**,** that all systems, subsystems, component parts, and software are fully free from defective design, materials, and workmanship for a period of one year.

1.05 SUBMITTALS, DOCUMENTATION, ACCEPTANCE AND TRAINING

A. Submittals
   1. Shop Drawings. A minimum of six (6) copies of shop drawings shall be submitted and shall consist of a complete list of equipment, materials, manufacturer's technical literature, cut-sheets, and installation instructions. Drawings shall contain proposed layout, complete wiring, routing, schematic diagrams, tag number of devices, software descriptions, calculations, installation details, and any other details required to demonstrate that the system will function properly.
   2. Graphical Programming Documentation: The Contractor shall provide a printout all Graphical Programs, identifying the specific HVAC or mechanical/electrical subsystem being controlled
   3. Drawing Approval. Shop drawings shall be approved before any equipment is installed. Controls contractor shall allow a minimum of fourteen (14) days for drawing approval.
   4. As Built Drawings. All drawings shall be reviewed after the final system checkout and updated or corrected to provide 'as-built' drawings to show exact installation. All shop drawings will be acknowledged in writing before installation is started and again after the final checkout of the system. The system will not be considered complete until the 'as-built' drawings have received their final approval. The Contractor shall deliver **6** sets of 'as-built' drawings.

B. Documentation
   Operating and Maintenance (O&M) manuals for the system shall be made available electronically using Acrobat (PDF) format and include the following categories: Workstation User's Manual, Project Engineering Handbook, Software Documentation.
   1. BAS User's Manual shall contain as a minimum:
      a. System overview
      b. Networking concepts
      c. Launching a web browser from a networked PC/PDA and login
      d. Graphical User Interface (GUI) screen menus and their definitions
      e. Creating, modifying or deleting schedules
      f. Uploading and downloading software to the field hardware
      g. Creating historical trends, collecting trend data and generating trend graphs

h. Enabling and assigning alarms and messages to reporting actions/groups
i. Report generation and 'third party software'
j. Backing up software and data files

2. Project Engineering Manual shall contain as a minimum:
   a. System architecture overview
   b. Hardware cut-sheets and product descriptions
   c. The Contractor shall deliver six (6) sets of 'as-built' drawings. All drawings shall be reviewed after the final system checkout and updated to provide 'as-built' drawings. The system will not be considered complete until the 'as-built' drawings have received their final approval.
   d. Installation, mounting and connection details for all field hardware and accessories
   e. Commissioning, setup and backup procedures for all control modules/accessories, BAS server software, and database.
   f. Listing of basic terminology, alarms/messages, error messages and frequently used commands or shortcuts.
3. BAS Software Documentation shall contain as a minimum:
   a. The Contractor shall provide a printout all Graphical Programs, detailing their application to specific HVAC equipment and electrical/mechanical subsystems, together with a glossary or icon symbol library detailing the function of each graphical icon. Revisions made as a result of the submittal process, during the installation, start-up or acceptance portion of the project, shall be accurately reflected in the "as-builts".
   b. Graphical representation of the mechanical equipment hierarchy for the project including all equipment controlled by the BAS. For example: a VAV terminal box may be the source for increased cooling demand and require the primary VAV AHU to operate which, in turn, requires the chillers to operate.
   c. Detailed listing of all alarm and event messages programmed for designated mechanical/electrical equipment and required operator action.

C. Acceptance Test
1. Acceptance Testing. Upon completion of the installation, the Contractor shall start up the system and perform all necessary calibration, testing, and debugging operations. The Contractor in the presence of the Owner's representative shall perform an acceptance test.
2. Notice of Completion. When the system performance is deemed satisfactory, the system parts will be accepted for beneficial use and placed under warranty. At this time, a "notice of completion" shall be issued and the warranty period shall start.

D. System Training
1. System Use Instructions: Controls Contractor shall provide 16 Hours of onsite training for designated personnel in the operation, maintenance, and programming of the system.
2. Provide minimum three day Operator Training Class at BAS Manufacturer's Headquarters and Main Training Center
3. Provide Audio Visual Training CDS

PART 2 - SYSTEM SOFTWARE AND OPERATOR INTERFACE

2.01 SYSTEM OVERVIEW

The BAS contractor shall provide system software based on a server/thin-client architecture, designed around the open standards of web technology. The BAS server shall communicate using ASHRAE's BACnet/IP protocol. Server shall be accessed using a web browser over the DDC system intranet provided under this contract and remotely over the Internet. Operator shall monitor, control, and reprogram the system from any computer on the Owners network or from anywhere a web browser is available. Systems requiring going to the controlled facility to view system information or to make any program, schedule, or operation changes are unacceptable.

The intent of the thin-client architecture is to provide the operator(s) complete access to the BAS system via a web browser. The thin-client web browser Graphical User Interface (GUI) shall be browser and operating system agnostic, meaning it will support Microsoft Internet Explorer browsers (6.x or later versions), and Windows as well as non-Window operating systems. No special software, (active-x components or fat java clients) shall be required to be installed on the PC's / PDA's used to access the BAS via a web browser.

The BAS server software must support at least the following server platforms (Windows NT, Sun Solaris and Linux). The BAS server software shall be developed and tested by the manufacturer of the system standalone controllers and network controllers/routers. Third party manufactured and developed BAS software is not acceptable.

The web browser GUI shall provide a completely interactive user interface and must offer the following features as a minimum:

- Trending all system physical , software and calculated points
- Scheduling
- Downloading Memory to field devices
- Real time 'live' Graphic Program Diagnostics for troubleshooting
- Tree Navigation
- Parameter change of properties
- Setpoint Adjustments
- Alarm / Event information
- Configuration of operators
- Execution of global commands
- Color coded graphics to system setpoints
- System commissioning
- Environmental Index Indication
- Energy Reports
- Building Performance Dashboards
- Reports- Standard and Custom

- Location Dependent Security and Access

A. Software Components
All software components of the BAS system software shall be installed and completed in accordance with the specification. BAS system components shall include:
1. Server Software, Database and Web Browser Graphical User Interface
2. System Configuration Utilities for future modifications to the system
3. Graphical Programming
4. Direct digital control software
5. Application Software

B. BAS Server Database
The BAS server software shall utilize a Java DataBase Connectivity (JDBC) compatible database such as: MS Access, MS SQL 7.0, Oracle 8i or IBM DB2. BAS systems written to Proprietary databases are **NOT** acceptable.

C. Database Open Connectivity
The BAS server database shall be Java DataBase Connectivity (JDBC) compatible, allowing real time access of data via the following standard mechanisms:
1. Common Object Request Broker Architecture (CORBA)
2. OLE/OPC (for Microsoft Client's/Server platform only)
3. Import/Export of the database from or to XML (extensible Mark-up Language)

D. Communication Protocol(s)
The native protocol for the BAS server software shall be BACnet as defined by ASHRAE standard SPC135. In addition, the software shall be able to support concurrent operation of multiple standard and non-standard protocols such as:
1. MODBUS
2. SMNP

E. Cross Platform Capability
The BAS system software (client and server) shall be operating system and hardware agnostic, being able to run on Windows 98, Windows 2000, Windows NT, Sun Microsystems Solaris and Red Hat Linux

F. Thin Client – Web Browser Based
The GUI shall be thin client or browser based and shall meet the following criteria:
1. Web Browser's for PC's: Only a 6.x browser (Explorer/Navigator) will be required as the GUI, and a valid connection to the server network. No installation of any custom software shall be required on the operator's GUI workstation/client. Connection shall be over an intranet or the Internet. A firewall shall be installed (as necessary) to protect the customer's Intranet.
2. Secure Socket Layers: Communication between the Web Browser GUI and BAS server shall be encrypted using 128-bit encryption technology within Secure Socket Layers (SSL). Communication protocol shall be Hyper-Text Transfer Protocol (HTTP).

3. PDA's: BAS Server software must support other browsers used by Personal Digital Assistants like 3Com Palm Pilots and other Internet appliances specified herein.

2.02 WEB BROWSER GRAPHICAL USER INTERFACE

A. Web Browser Navigation

The Thin Client web browser GUI shall provide a comprehensive user interface. Using a collection of web pages, it shall be constructed to "feel" like a single application, and provide a complete and intuitive mouse/menu driven operator interface. It shall be possible to navigate through the system using a web browser to accomplish **2.2 B thru 2.2 J** of this specification. The Web Browser GUI shall (as a minimum) provide a Navigation Pane for navigation, and a Action Pane for display of animated graphics, schedules, alarms/events, live graphic programs, active graphic setpoint controls, configuration menus for operator access, reports, and reporting actions for events.

B. Login

On launching the web browser and selecting the appropriate domain name or IP address, the operator shall be presented with a login page that will require a login name and password. Navigation in the system shall be dependent on the operator's role privileges, and geographic area of responsibility (see 3.2 J below).

C. Navigation Pane

The Navigation Pane shall comprise a Navigation Tree which defines a geographic hierarchy of the proposed BAS system. Navigation through the GUI shall be accomplished by clicking on appropriate level of a navigation tree (consisting of expandable and collapsible tree control like Microsoft's Explorer program), and/or by selecting dynamic links to other system graphics. Both the navigation tree and graphic pane defined in 2.2 D shall be displayed simultaneously, enabling the operator to select a specific system or equipment, and view the graphic corresponding to the highlighted position in the navigation tree. The navigation tree shall as a minimum provide the following views: Geographic, Network, Groups and Configuration.

1. Geographic View shall display a logical geographic hierarchy of the system including cities, sites, buildings, building systems, floors, equipment and BACnet objects.
2. Network View shall display the hierarchy of the actual BACnet IP Intranet network. This can include: Systems, Site, Networks, Routers, Half-Routers, Devices, Equipment and all the BACnet Objects in a device.
3. Groups View shall display Scheduled Groups and custom reports.
4. Configuration View shall display all the configuration categories (Operators, Schedule, Event, Reporting and Roles).

D. Action Pane

The Action Pane shall provide several functional views for each HVAC or mechanical/electrical subsystem specified. By clicking on a button, an operator shall be able to select the following system page, corresponding to the highlighted area/equipment in the navigation tree:

1. Graphics: Using animated gifs or other graphical format suitable for display in a web browser, graphics shall include aerial building/campus views, color building

floor-plans, equipment drawings of each individual piece of equipment with live variable statuses, active graphic setpoint controls, web content, and other valid HTML elements. The data on each graphic page shall automatically refresh at a rate defined by the operator.

2. Properties: Shall include graphic controls and text for the following: Locking or overriding BACnet objects, demand strategies, and any other valid data required for setup. Changes made to the properties pages shall require the operator to depress a 'accept/cancel' button.
3. Schedules: Shall be used to create, modify/edit and view schedules based on the systems geographical hierarchy (using the navigation tree) and in compliance with section 2.2.G
4. Events: Shall be used to view alarm event information geographically (using the navigation tree), acknowledge events, sort events by category, actions and verify reporting actions.
5. Trends: Shall be used to display associated trend and historical data, modify colors, date range, axis and scaling
6. Logic - Live Graphic Programs: Shall be used to display a 'live' graphic program of the control algorithm for the mechanical/electrical system selected in the navigation tree. All control outputs and inputs shall be displayed on the program giving real-time statuses for use in operator troubleshooting.

The following actions shall be accomplished by clicking appropriate buttons/menu in the graphic window: Log In/Out, Print and Hide/Show Navigation Pane.

E. Color Graphics

The Web Browser GUI shall make extensive use of color in the graphic pane to communicate information related to setpoints and comfort. Animated gif's, active setpoint graphic controls and valid web content (like local weather forecast) shall be used to enhance usability:

1. Display Size: The GUI workstation software shall graphically display in 1024 by 768 pixels 24 bit True Color.
2. General Graphic: General area maps shall show locations of controlled buildings in relation to local landmarks.
3. Color Floor Plans: Floor plan graphics shall show heating and cooling zones throughout the buildings in a range of colors, which provide a visual display of temperature relative to their respective setpoints (see section 3.2 F below). The colors shall be updated dynamically as a zone's actual comfort condition changes in real-time. Locations of space sensors shall also be shown for each zone. The intent of the specification is to enable the operator to readily assess problems at a glance.
4. Mechanical Components: Mechanical system graphics shall show the type of mechanical system components serving any zone through the use of a pictorial representation of components. Selected I/O points being controlled or monitored for each piece of equipment shall be displayed with the appropriate engineering units. Animation shall be used for rotation or moving mechanical components to enhance usability.
5. Minimum System Color Graphics: Color graphics shall be selected and displayed via a web browser for the following:
   a. Each piece of equipment monitored or controlled including each terminal unit

b. Each building
c. Each floor and zone controlled

F. Zone Setpoint Adjustments
Color floor plans displayed via a web browser shall utilize a contiguous band of colors, each corresponding to actual zone temperatures relative to the desired heating and cooling setpoints. The ideal temperature shall be shown as a green color band. Temperatures slightly warmer than ideal shall be shown in yellow, and even warmer temperature band shall be shown in orange. Temperatures slightly cooler than ideal shall be light blue, and even cooler temperatures shall be shown as dark blue. All alarm colors shall be in red.

G. Hierarchical Schedules
Utilizing the Navigation Tree displayed in the web browser GUI, an operator (with password access) shall be able to define a Normal, Holiday or Override schedule for an individual piece of equipment or room, or choose to apply a hierarchical schedule to the entire system, site or floor area.
All schedules that affect the system/area/equipment highlighted in the Navigation Tree shall be shown in a summary schedule table and graph.
1. BACnet Schedules: Schedules shall comply with the BACnet standard, (Schedule Object, Calendar Object, Weekly Schedule property and Exception Schedule property) and shall allow events to be scheduled based on:
   a. Types of schedule shall be Normal, Holiday or Override
   b. A specific date,
   c. A range of dates,
   d. Any combination of Month of Year (1-12, any), Week of Month (1-5, last, any), Day of Week (M-Sun, Any)
   e. Wildcard (example, allow combinations like second Tuesday of every month).
2. Schedule Categories: The system shall allow operators to define and edit scheduling categories (different types of "things" to be scheduled; for example, lighting, HVAC occupancy, etc.). The categories shall include name, description, icon (to display in the hierarchy tree when icon option is selected) and type of value to be scheduled.
3. Schedule Groups: In addition to hierarchical scheduling, operators shall be able to define functional Schedule Groups, comprised of an arbitrary group of areas/rooms/equipment scattered throughout the facility and site. For example, the operator shall be able to define an 'individual tenant' group – who may occupy different areas within a building or buildings. Schedules applied to the 'tenant group' shall automatically be downloaded to control modules affecting spaces occupied by the 'tenant group'
4. Schedules shall as a minimum control occupancy modes on HVAC systems. Schedules shall control occupied, unoccupied and special modes (security, cleaning etc.) for lighting system. System shall allow the operator to designate a common occupancy schedule to be used for both HVAC and lighting.
5. Intelligent Scheduling: The control system shall be intelligent enough to automatically turn on any supporting equipment needed to control the environment in an occupied space. If the operator schedules an individual room in a VAV system for occupancy, the control logic shall automatically turn on the

VAV air handling unit, chiller, boiler, and/or any other equipment required to maintain the specified comfort and environmental conditions within the room.

6. Partial Day Exceptions: Schedule events shall be able to accommodate a time range specified by the operator.
7. Schedule Summary Graph: The schedule summary graph shall clearly show Normal versus Holiday versus Override Schedules, and the net operating schedule that results from all contributing schedules. Note: In case of priority conflict between schedules at the different geographic hierarchy, the schedule for the more detailed geographic level shall apply.
8. Schedule Distribution: For reliability and performance, instead of maintaining a single schedule in a field device that writes over the network to notify other devices when a scheduled event occurs, field devices will only keep their part of the schedule locally. The BAS server software shall determine which nodes a hierarchical schedule applies to and will create/modify the necessary schedule objects in each field device as necessary.

H. Events (& Alarms)

Events and alarms associated with a specific system, area, or equipment selected in the Navigation Tree, shall be displayed in the Action Pane by selecting an 'Events' view. Events, alarms, and reporting actions shall have the following capabilities:

1. Events View: Each event shall display an Event Category (using a different icon for each event category), date/time of occurrence, current status, event report, and a URL link to the associated graphic for the selected system, area or equipment. The URL link shall indicate the system location, address and other pertinent information. An operator shall easily be able to sort events, edit event templates and categories, acknowledge or force a return to normal in the Events View as specified in this section.
2. Event Categories: The operator shall be able to create, edit or delete event categories such as HVAC, Maintenance, Fire, or Generator. An icon shall be associated with each Event category, enabling the operator to easily sort through multiple events displayed using a built-in filter.
3. BACnet Event Templates: BACnet Event template shall define different types of alarms and their associated properties. As a minimum, properties shall include a reference name, verbose description, severity of event, acknowledgement requirements, high/low limit and out of range information.
4. Event Areas: Event Areas enable an operator to assign specific Event Categories to specific Event Reporting Actions.
5. Event Time/Date Stamp: All events shall be generated at the DDC control module level and comprise the Time/Date Stamp using the standalone control module time and date.
6. Event Configuration: Operators shall be able to define the type of events generated per BACnet object. A 'network' view of the Navigation Tree shall expose all BACnet objects and their respective Event Configuration. Configuration shall include assignment of event, alarm, type of Acknowledgement and notification for return to normal or fault status.
7. Event Summary Counter: The view of events in the Graphic Pane shall provide a numeric counter, indicating how many events are active (in alarm), require acknowledgement, and total number of events in the BAS Server database.

8. Persistent Data. The system shall allow for external systems to access the event instance data. Event data shall be stored and queried in the database in a relational manner. At a minimum, the fields to be stored in the database are:
   - Event Source
   - Event Generation Time
   - Acknowledge Required Flag
   - Delivery Priority
   - BACnet Event Type
   - Event Message Text
   - BACnet Event Parameter
   - Classification of Event
   - Event Acknowledgement Time
   - Return to Normal Time
   - Operator Comments
   - Who Acknowledged the Event
9. Event Auto-Deletion: Events that are acknowledged and closed shall be auto-deleted from the database and archived to a text file after an operator defined period.
10. Event Reporting Actions: Event Reporting Actions specified shall be automatically launched (under operator defined conditions) after an event is received by the BAS server software. Operators shall be able to fully define these Reporting Actions using the Navigation Tree and Graphic Pane in the web browser GUI. Reporting Actions shall be as follows:
    a. Print: Alarm/Event information shall be printed to the BAS server's PC or a networked printer.
    b. Email: Email shall be sent via any POP3-compatible e-mail server (most Internet Service Providers use POP3). Email messages may be copied to several email accounts.

       Note: Email reporting action shall also be used to support alphanumeric paging services, where email servers support pagers.

    c. File Write: The ASCII File write reporting action shall enable the operator to append operator defined alarm information to any alarm through a text file. The alarm information that is written to the file shall be completely definable by the operator. The operator may enter text or attach other data point information (such as AHU discharge temperature and fan condition upon a high room temperature alarm).
    d. Write Property: The write property reporting action updates a property value in a hardware module.
    e. SNMP: The Simple Network Management Protocol (SNMP) reporting action sends an SNMP trap to a network in response to receiving an event.
    f. Run External Program: The Run External Program reporting action launches specified program in response to an event.
11. Event Simulator: The web browser GUI user shall provide an Event Simulator to test assigned Reporting Actions. The operator shall have the option of using current time or scheduling a specific time to generate the Event. Utilizing the Navigation Tree and drop-down menus in the Graphic Pane, the operator shall be able to select the Event Type, Status, Notification, Priority, Message, and whether acknowledgement is required.

12. External Injection of Events. The BAS server software shall provide a CORBA interface for external injection of events, allowing the system to receive/report events generated from external source other than the BAS system.

I. Trends

Trends shall conform to the BACnet Trend Log Object specification. The system shall be able to trend and display graphically all analog, digital or calculated points simultaneously. A trend log's properties shall be editable using the Navigation Tree and Graphic Pane.

1. Viewing Trends: The operator shall have the ability to view trends by using the Navigation Tree and selecting a Trends button in the Graphic Pane. The system shall allow y- and x-axis maximum ranges to be specified and shall be able to simultaneously graphically display multiple trends per graph.
2. Local Trends: Trend data shall be collected locally by Multi-Equipment/Single Equipment general-purpose controllers, and periodically uploaded to the BAS server if historical trending is enabled for the BACnet object. Trend data, including run time hours and start time date shall be retained in non-volatile module memory
3. Resolution. Sample intervals shall be as small as one (0.1) second. Each trended point will have the ability to be trended at a different trend interval. When multiple points are selected for display that have different trend intervals, the system will automatically scale the axis.
4. Dynamic Update. Trends shall be able to dynamically update at operator-defined intervals.
5. Zoom. It shall be possible to zoom-in on a particular section of a trend for more detailed examination.
6. Numeric Value Display. It shall be possible to pick any sample on a trend and have the numerical value displayed.

J. Security Access

Secure access from the web browser GUI to BAS server shall require a Login Name and Password. Access to different areas of the BAS system shall be defined in terms of Roles, Privileges and geographic area of responsibility as specified:

1. Roles: Roles shall reflect the actual roles of different types of operators. Each role shall comprise a set of easily understood English language' privileges. Roles shall be defined in terms of View, Edit and Function Privileges. Systems that use cryptic Boolean numbers to define system access are not acceptable.
    a. View Privileges shall comprise Navigation, Network, and Configuration Trees, Operators, Roles and Privileges, Alarm/Event Template and Reporting Action.
    b. Edit Privileges shall comprise Setpoint, Tuning and Logic, Manual Override, and Point Assignment Parameters.
    c. Function Privileges shall comprise Alarm/Event Acknowledgement, Control Module Memory Download, Upload, Schedules, Schedule Groups, Manual Commands, Print, and Alarm/Event Maintenance.
2. Geographic Assignment of Roles: Roles shall be geographically assigned using a similar expandable/collapsible navigation tree.

2.03 GRAPHICAL PROGRAMMING

The system software shall include a Graphic Programming Language (GPL) for all DDC control algorithms resident in standalone control modules. Any system that does not use a drag and drop method of graphical icon programming as described herein shall be unacceptable. GPL is a method used to create a sequence of operations by assembling graphic microblocks that represent each of the commands or functions necessary to complete a control sequence of operation. Microblocks represent common logical control devices used in conventional control systems, such as relays, switches, high signal selectors, etc., in addition to the more complex DDC and energy management strategies such as PID loops and optimum start. Each microblock shall be interactive and contain the programming necessary to execute the function of the device it represents.

Graphic programming shall be performed while on screen and using a mouse; each microblock shall be selected from a microblock library and assembled with other microblocks necessary to complete the specified sequence. Microblocks are then interconnected on screen using graphic "wires," each forming a logical connection. Once assembled, each logical grouping of microblocks and their interconnecting wires then forms a graphic function block which may be used to control any piece of equipment with a similar point configuration and sequence of operation.

A. Graphic Sequence
The clarity of the graphic sequence must be such that the operator has the ability to verify that system programming meets the specifications, without having to learn or interpret a manufacturer's unique programming language. The graphic programming must be self-documenting and provide the operator with an understandable and exact representation of each sequence of operation.

B. Simulation
Full simulation capability shall be provided with the graphic programming. Operator shall be able to fully simulate the constructed control sequence prior to downloading into field control modules. Simulation capabilities shall include step-by-step, accelerated time, and operator defined simulation criteria like outside weather, demand, and communication status. Multiple graphic programs shall be simulated and displayed in split screens at the same time.

C. GPL Capabilities
The following is a minimum definition of the capabilities of the Graphic Programming software:
1. Function Block (FB): Shall be a collection of points, microblocks and wires which have been connected together for the specific purpose of controlling a piece of HVAC equipment or a single mechanical system.
2. Logical I/O: Input/Output points shall interface with the control modules in order to read various signals and/or values or to transmit signal or values to controlled devices.
3. BACnet Points: Shall be points that comply with the BACnet structure as defined in the BIBB’s Addendum B1/B2, and the BACnet standard.

4. Microblocks: Shall be software devices that are represented graphically and may be connected together to perform a specified sequence. A library of microblocks shall be submitted with the control contractors bid.
5. Wires: Shall be graphical elements used to form logical connections between microblocks and between logical I/O. Different wire types shall be used depending on whether the signal they conduct is analog or digital.
6. Labels: Labels shall be similar to wires in that they are used to form logical connections between two points. Labels shall form a connection by reference instead of a visual connection; i.e. two points labeled 'A' on a drawing are logically connected even though there is no wire between them.
7. Parameter: A parameter shall be a value that may be tied to the input of a microblock.
8. Properties: Dialog boxes shall appear after a microblock has been inserted which has editable parameters associated with it. Default parameter dialog boxes shall contain various editable and non-editable fields and shall contain 'push buttons' for the purpose of selecting default parameter settings.
9. Icon: An icon shall be graphic representation of a software program. Each graphic microblock has an icon associated with it that graphically describes it function.
10. Menu-bar Icon: Shall be an icon that is displayed on the menu bar on the GPL screen, which represents its associated graphic microblock.
11. Live Graphical Programs: The Graphic Programming software must support a 'live' mode, where all input/output data, calculated data, and setpoints shall be displayed in a 'live' real-time mode. For each piece of HVAC equipment, the graphic program shall be complete and viewed on one screen. For example, a graphic program used for an Air Handling Unit shall not be broken down into separate components and require an operator to view only one component at any one time.

2.04 SYSTEM TOOLS

System shall provide the following functionality to authorized operators as an integral part of the operator interface.

A. Automatic System Database Configuration. Each workstation or web server shall store on its hard disk a copy of the current system database, including controller firmware and software. Stored database shall be automatically updated with each system configuration or controller firmware or software change.
   1. Controller Memory Download. Operators shall be able to download memory from the system database to each controller.
   2. System Configuration. Operators shall be able to configure the system.
   3. Online Help. Context-sensitive online help for each tool shall assist operators in operating and editing the system.
   4. Security. System shall require a user name and password to view, edit, add, or delete data.
      a. Operator Access. Each user name and password combination shall define accessible viewing, editing, adding, and deleting functions in each system application, editor, and object. Authorized operators shall be able to vary and deny each operator's accessible functions based on equipment or geographic location.
      b. Automatic Log Out. Automatically log out each operator if no keyboard or

mouse activity is detected. Operators shall be able to adjust automatic log out delay.

c. Encrypted Security Data. Store system security data including operator passwords in an encrypted format. System shall not display operator passwords.

5. System Diagnostics. System shall automatically monitor controller and I/O point operation. System shall annunciate controller failure and I/O point locking (manual overriding to a fixed value).
6. Alarm Processing. System input and status objects shall be configurable to alarm on departing from and on returning to normal state. Operator shall be able to enable or disable each alarm and to configure alarm limits, alarm limit differentials, alarm states, and alarm reactions for each system object. Configure and enable alarm points as specified in Section 15900 Part 5 Sequences of Operation. Alarms shall be BACnet alarm objects and shall use BACnet alarm services.
7. Alarm Messages. Alarm messages shall use an English language descriptor without acronyms or mnemonics to describe alarm source, location, and nature.
8. Alarm Reactions. Operator shall be able to configure (by object) actions workstation or web server shall initiate on receipt of each alarm. As a minimum, workstation or web server shall be able to log, print, start programs, display messages, send e-mail, send page, and audibly annunciate. The send e-mail alarm action should be able to run a report and attach it to the e-mail. The e-mail should use SSL to secure the communications between the system server and the mail server.
9. Alarm Maintenance. Operators shall be able to view system alarms and changes of state chronologically, to acknowledge and delete alarms, and to archive closed alarms to the workstation or web server hard disk from each workstation or web browser interface.
10. Trend Configuration. Operator shall be able to configure trend sample or change of value (COV) interval, start time, and stop time for each system data object and shall be able to retrieve data for use in spreadsheets and standard database programs. Controller shall sample and store trend data and shall be able to archive data to the hard disk. Configure trends as specified in Section 230900 Part 5 Sequences of Operation. Trends shall be BACnet trend objects.
11. Object and Property Status and Control. Operator shall be able to view, and to edit if applicable, the status of each system object and property by menu, on graphics, or through custom programs.

B. Reports and Logs. Operator shall be able to select, to modify, to create, and to print reports and logs. Operator shall be able to store report data in a format accessible by standard spreadsheet and word processing programs.
   1. Standard Reports. Furnish the following standard system reports:
      a. Objects. System objects and current values filtered by object type, by status (in alarm, locked, normal), by equipment, by geographic location, or by combination of filter criteria.
      b. Alarm Summary. Current alarms and closed alarms. System shall retain closed alarms for an adjustable period.
      c. Logs. System shall log the following to a database or text file and shall retain data for an adjustable period:

i. Alarm History.
ii. Trend Data. Operator shall be able to select trends to be logged.
iii. Operator Activity. At a minimum, system shall log operator log in and log out, control parameter changes, schedule changes, and alarm acknowledgment and deletion. System shall date and time stamp logged activity.

2. Custom Reports. Operator shall be able to create custom reports that retrieve data, including archived trend data, from the system, that analyze data using common algebraic calculations, and that present results in tabular or graphical format. Reports shall be launched from the operator interface.
3. Energy Reports. System shall include an easily configured energy reporting tool that provides the capabilities described in this section.
   a. The energy reporting tool shall be accessible through the same user interface (Web browser or operator workstation software) as is used to manage the BAS.
   b. The energy reporting tool shall be preconfigured by the Contractor to gather and store energy demand and consumption data from each energy source that provides metered data to the BAS. Meter data shall be stored at 5 minute intervals unless otherwise specified in the Sequence of Operation provided in Appendix A. This data shall be maintained in an industry standard SQL database for a period of not less than five years.
   c. The energy reporting tool shall allow the operator to select an energy source and a time period of interest (day, week, month, year, or date range) and shall provide options to view the data in a table, line graph, bar graph, or pie chart. The tool shall also allow the operator to select two or more data sources and display a comparison of the energy used over this period in any of the listed graph formats, or to total the energy used by the selected sources and display that data in the supported formats.
   d. The energy reporting tool shall allow the operator to select an energy source and two time periods of interest (day, week, month, year, or date range) and display a graph that compares the energy use over the two time periods in any of the graph formats listed in the previous paragraph. The tool shall also allow the operator to select multiple energy sources and display a graph that compares the total energy used by these sources over the two time periods.
   e. The energy reporting tool shall allow the operator to easily generate the previously described graphs "on the fly," and shall provide an option to store the report format so the operator can select that format to regenerate the graph at a future date. The tool shall also allow the user to schedule these reports to run on a recurring basis using relative time periods, such as automatically generating a consumption report on the first Monday of each month showing consumption over the previous month. Automatically generated reports shall be archived on the server in a common industry format such as Adobe PDF or Microsoft Excel with copies e-mailed to a user editable list of recipients.
   f. The energy reporting tool shall be capable of collecting and displaying data from the following types of meters:

      i. Electricity

ii. Gas
iii. Oil
iv. Steam
v. Chilled Water
vi. Potable Water
vii. Heating and cooling degree days. (May be calculated from sensor data rather than metered.)
viii. Electricity

g. The user shall have the option of using Kw (Kwh) or Btu/hr (Btu) as the units for demand and consumption reports. Multiples of these units (MWH, kBtu, etc.) shall be used as appropriate. All selected sources shall be automatically converted to the selected units. The user shall similarly have the option of entering facility area and occupancy hours and creating reports that are normalized on an area basis, an annual use basis, or an occupied hour basis.
h. The user shall have the option of entering benchmark data for an individual facility or a group of facilities.
i. The user shall have the option of displaying any or all of the following data on any chart, line, or bar graph generated by the energy reporting tool:

i. Low/High/Average value of the metered value being displayed.
ii. Heating and/or Cooling Degree Days for the time period(s) being displayed.
iii. The Environmental Index for the facilities and time periods being displayed.

C. Building Performance
1. Environmental Index. System shall monitor all occupied zones and compile an index that provides a numerical indication of the environmental comfort within the zone. As a minimum, this indication shall be based upon the deviation of the zone temperature from the heating or cooling setpoint. If humidity is being measured within the zone then the environmental index shall be adjusted to reflect a lower comfort level for high or low humidity levels. Similarly, if carbon dioxide levels are being measured as an indication of ventilation effectiveness then the environmental index shall be adjusted to indicate degraded comfort at high carbon dioxide levels. Other adjustments may be made to the environmental index based upon additional measurements. The system shall maintain a trend of the environmental index for each zone in the trend log. The system shall also compute an average comfort index for every building included in this contract and maintain trend logs of these building environmental indices. Similarly, the system shall compute the percentage of occupied time that comfortable conditions were maintained within the zones. Through the UI the user shall be able to add a weighting factor to adjust the contribution of each zone to the average index based upon the floor area of the zone, importance of the zone, or other static criteria.

D. Graphics Generation. Graphically based tools and documentation shall allow Operator to edit system graphics, to create graphics, and to integrate graphics into the system.

Operator shall be able to add analog and binary values, dynamic text, static text, and animation files to a background graphic using a mouse.

1. Graphics Library. Complete library of standard HVAC equipment graphics shall include equipment such as chillers, boilers, air handlers, terminals, fan coils, and unit ventilators. Library shall include standard symbols for other equipment including fans, pumps, coils, valves, piping, dampers, and ductwork. Library graphic file format shall be compatible with graphics generation tools.

E. Custom Application Programming. Operator shall be able to create, edit, debug, and download custom programs. System shall be fully operable while custom programs are edited, compiled, and downloaded. Programming language shall have the following features:

1. Language. Language shall be graphically based and shall use function blocks arranged in a logic diagram that clearly shows control logic flow. Function blocks shall directly provide functions listed below, and operators shall be able to create custom or compound function blocks.
2. Programming Environment. Tool shall provide a full-screen, cursor-and-mouse-driven programming environment that incorporates word processing features such as cut and paste. Operators shall be able to insert, add, modify, and delete custom programming code, and to copy blocks of code to a file library for reuse in other control programs.
3. Independent Program Modules. Operator shall be able to develop independently executing program modules that can disable, enable and exchange data with other program modules.
4. Debugging and Simulation. Operator shall be able to step through the program observing intermediate values and results. Operator shall be able to adjust input variables to simulate actual operating conditions. Operator shall be able to adjust each step's time increment to observe operation of delays, integrators, and other time-sensitive control logic. Debugger shall provide error messages for syntax and for execution errors.
5. Conditional Statements. Operator shall be able to program conditional logic using compound Boolean (AND, OR, and NOT) and relational (EQUAL, LESS THAN, GREATER THAN, NOT EQUAL) comparisons.
6. Mathematical Functions. Language shall support floating-point addition, subtraction, multiplication, division, and square root operations, as well as absolute value calculation and programmatic selection of minimum and maximum values from a list of values.
7. Variables: Operator shall be able to use variable values in program conditional statements and mathematical functions.

    i. Time Variables. Operator shall be able to use predefined variables to represent time of day, day of the week, month of the year, and date. Other predefined variables or simple control logic shall provide elapsed time in seconds, minutes, hours, and days. Operator shall be able to start, stop, and reset elapsed time variables using the program language.
    ii. System Variables. Operator shall be able to use predefined variables to represent status and results of Controller Software and shall be able to enable, disable, and change setpoints of Controller Software as described in Controller Software section.

F. Portable Operator's Terminal. Provide all necessary software to configure an IBM-compatible laptop computer for use as a Portable Operator's Terminal. Operator shall be able to connect configured Terminal to the system network or directly to each controller for programming, setting up, and troubleshooting.

PART 3 – PRODUCTS HARDWARE

3.01 COMMUNICATION

A. Control products, communication media, connectors, repeaters, hubs, and routers shall comprise a BACnet internetwork. Controller and operator interface communication shall conform to ANSI/ASHRAE Standard 135-2004, BACnet. No exceptions acceptable.

B. Install new wiring and network devices as required to provide a complete and workable control network. Use existing Ethernet backbone for network segments marked "existing" on project drawings.

C. Each controller shall have a communication port for temporary connection to a laptop computer or other operator interface. Connection shall support memory downloads and other commissioning and troubleshooting operations.

D. Internetwork operator interface and value passing shall be transparent to internetwork architecture.
   1. An operator interface connected to a controller shall allow the operator to interface with each internetwork controller as if directly connected. Controller information such as data, status, and control algorithms shall be viewable and editable from each internetwork controller.
   2. Inputs, outputs, and control variables used to integrate control strategies across multiple controllers shall be readable by each controller on the internetwork. Program and test all cross-controller links required to execute control strategies specified in Section 230900 Part 5 Sequences of Operation. An authorized operator shall be able to edit cross-controller links by typing a standard object address or by using a point-and-click interface.

E. Controllers with real-time clocks shall use the BACnet Time Synchronization service. System shall automatically synchronize system clocks daily from an operator-designated controller via the internetwork. System shall automatically adjust for daylight saving and standard time.

F. System shall be expandable to at least twice the required input and output objects with additional controllers, associated devices, and wiring.

G. System shall support Web services data exchange with any other system that complies with XML (extensible markup language) and SOAP (simple object access protocol) standards specified by the Web Services Interoperability Organization (WS-I) Basic Profile 1.0 or higher. Web services support shall as a minimum be provided at the workstation or web server level and shall enable data to be read from or written to the system.

1. System shall support Web services read data requests by retrieving requested trend data or point values (I/O hardware points, analog value software points, or binary value software points) from any system controller or from the trend history database.
2. System shall support Web services write data request to each analog and binary object that can be edited through the system operator interface by downloading a numeric value to the specified object.
3. For read or write requests, the system shall require user name and password authentication and shall support SSL (Secure Socket Layer) or equivalent data encryption.
4. System shall support discovery through a Web services connection or shall provide a tool available through the Operator Interface that will reveal the path/identifier needed to allow a third party Web services device to read data from or write data to any object in the system which supports this service.

3.02 NETWORK ROUTERS & BRIDGES

The DDC/BAS controller network shall use BACnet as its native communication protocol. Network bridges and routers must be of a modular design to ensure reliability and system performance.

A. BACnet Router
The central system shall use the DDC/BAS Local Area Network (LAN) provided under this contract for communication. The communication between the central server and the controllers shall be BACnet/IP. A router shall be provided, as required, to bridge BACnet/IP and the data link used between the controllers (BACnet ARCNET and BACnet MS/TP). Proprietary networks and proprietary protocols are not acceptable.
1. Firmware Updates: The BACnet Router must utilize FLASH memory to allow firmware updates to be performed remotely.

3.03 STANDALONE CONTROLLERS

A. Each lighting control panel shall reside on a BACnet network using ISO 8802-3 (Ethernet) Data Link/Physical layer protocol with BACnet/IP addressing, or it shall reside on a BACnet network using ARCNET or MS/TP Data Link/Physical layer protocol. Non-BACnet protocols shall be acceptable for I/O networks connecting the lighting control panel to intelligent switches, lighting relays, and other lighting accessories.

B. General Purpose Multiple Application Controllers
BACnet BIBBS: General Purpose Multiple Application controllers shall use BACnet as the native communication protocol between controllers.
1. Communication Speed: Controllers shall communicate at a minimum of 156 Kbps using ARCNET implemented over EIA-485 using an unshielded twisted pair at the Data Link Layer.
2. General Specification: Each General Purpose Multiple Application Controller shall be a standalone direct digital operation utilizing its own 32 bit processor, non-volatile flash memory, input/output, 12 bit A to D conversion, hardware clock/calendar and voltage transient and lightning protection devices. A separate

co-processor shall be used for communications to the controller network. All non-volatile flash memory shall have a battery backup of at least five years. Firmware revisions to the module shall be made from the BAS server or remotely over the Intranet or Internet. Controllers that require component changes to implement firmware revisions are not acceptable.

3. Point Expansion: The General Purpose Multiple Application Controllers shall be expandable to the specified I/O point requirements. Each controller shall accommodate multiple I/O Expander Modules via a designated expansion I/O bus port. These expander modules shall expand the total point capacity of each controller up to 192 points where specified. The controller, in conjunction with the expansion modules, shall act as one standalone controller.
4. Point Programming: All point data, algorithms and application software within a controller shall be custom programmable from the operator workstation.
5. Program Execution: Each General Purpose Multiple Application Controller shall execute application programs, calculations, and commands via a 32-bit microcomputer resident in the controller. All operating parameters for application programs residing in each controller shall be stored in read/writable nonvolatile flash memory within the controller and will be able to upload/download to/from the BAS Server.
6. Self-Test Diagnostics: Each controller shall include self-test diagnostics, enabling the controller to report malfunctions to the router and BAS Server.
7. PID Loops: Each General Purpose Multiple Application Controller shall contain both software and firmware to perform full DDC Proportional, Integral, Derivative (PID) control loops and programs.
8. Input-Output Processing:
    a. Digital Outputs shall be relays, 24 Volts AC or DC maximum, 3-amp maximum current. Each configured as normally open or normally closed using jumpers and either dry contact or bussed. Each output shall have a manual Hand-Off-Auto switch to allow for override and an LED to indicate the operating mode of the output. Triac outputs are unacceptable.
    b. Universal Inputs shall be Thermistor (BAPI Curve II) 10K Ohm at 77°F (25°C), 0-5VDC, 10K Ohm maximum source impedance, 0-20mA - 24 VDC loop power, 250 Ohm input impedance, dry contact - 0.5mA maximum current.
    c. Analog Output shall be electronic, voltage mode 0-10VDC or current mode 4-20mA.

C. General Purpose Single Application Controllers
1. BACnet BIBBS: The General Purpose Single Application Controllers must use BACnet as the native communication protocol between controllers.
2. Communication Speed: Controllers shall communicate at a minimum of 156 Kbps using ARCNET implemented over EIA-485 using an unshielded twisted pair at the Data Link Layer.
3. General Specification: General Purpose Single Application controllers must be capable of stand-alone DDC operation utilizing its own 32 bit processor, nonvolatile flash memory, input/output, 8 bit A to D conversion, hardware clock/calendar and voltage transient protection devices. A separate co-processor shall be used for communications to the controller network. All RAM memory shall have a battery backup of at least five years. Firmware revisions to the

module shall be made from the BAS server, or remote locations over the Internet. Controllers that require component changes to implement Firmware revisions are not be acceptable.

4. Point Programming: All point data, algorithms, and application software within the controllers shall be custom programmable from the Operator Workstation.
5. Program Execution: Each General Purpose Single Application Controller shall execute application programs, calculations, and commands via a 32-bit microcomputer resident in the controller. All operating parameters for the application program residing in each controller shall be stored in read/writable nonvolatile flash memory within the controller and will be able to upload/download to/from the Operator Workstation.
6. Self-Test Diagnostics: Each controller shall include self-test diagnostics, enabling the controller to report malfunctions to the router and BAS Server input.
7. PID Loops: Each General Purpose Single Application Controller shall contain both software and firmware to perform full DDC PID control loops.
8. Rooftop Mounting: The General Purpose Single Application Controllers shall be capable of being mounted directly in or on rooftop AHU equipment.
9. Operating Temperature: The General Purpose Single Application Controllers shall be capable of proper operation in an ambient temperature environment of -20°F to +150°F (-28.9° to 65.6°C).
10. Input-Output Processing:
    a. Digital Outputs shall be relays, 24 Volts AC or DC maximum, 3 amp maximum current. Each output shall have a manual Hand-Off-Auto switch to allow for override and an LED to indicate the operating mode of the output. Triac outputs are unacceptable.
    b. Universal Inputs shall be Thermistor (BAPI Curve II) 10K Ohm at 77°F (25°C), 0-5VDC - 10K Ohm maximum source impedance, 0-20mA - 24 VDC loop power, 250 Ohm input impedance, Dry Contact - 0.5mA maximum current.
    c. Analog Electronic Outputs shall be voltage mode 0-10VDC or current mode 4-20mA.

3.04 FIELD HARDWARE/INSTRUMENTATION

A. Temperature Sensing Devices
   1. Type & Accuracy. Temperature sensors shall be of the type and accuracy indicated for the application. Sensors shall have an accuracy rating within 1% of the intended use temperature range.
   2. Air Handling Unit Coil Temperature Sensors. Sensors shall be averaging type with 1 linear foot sensor to 1 square foot of coil.
   3. Outside Air Temperature Sensors. Outside air temperature sensors accuracy shall be within +1°F (0.5°C) in the range of -52°F to 152°F (-46.6°C to 66.6°C).
   4. Room Temperature Sensors. Room temperature sensors shall have an accuracy of +0.36°F (0.25°C) in the range of 32°F to 96°F (0°C to 35.5°C).
   5. Chilled Water and Condenser Water Sensors. Chilled water and condenser water sensors shall have an accuracy of +0.25°F (0.15°C) in their range of application.
   6. Hot Water Temperature Sensors. Hot water temperature sensors shall have an accuracy of +0.75°F (0.3°C) over the range of their application.

B. Pressure Instruments
   1. Differential Pressure and Pressure Sensors: Sensors shall have a 4-20 MA output proportional signal with provisions for field checking. Sensors shall withstand up to 150% of rated pressure, without damaging the device. Accuracy shall be within ±2% of full scale. Sensors shall be manufactured by Leeds & Northrup, Setra, Robertshaw, Dwyer Instruments, Rosemont, or be approved equal.
   2. Pressure Switches: Pressure switches shall have a repetitive accuracy of ±2% of range and withstand up to 150% of rated pressure. Sensors shall be diaphragm or bourdon tube design. Switch operation shall be adjustable over the operating pressure range. The switch shall have an application rated Form C, snap-acting, self-wiping contact of platinum alloy, silver alloy, or gold plating.

C. Flow Switches
   Flow switches shall have a repetitive accuracy of ±1% of their operating range. Switch actuation shall be adjustable over the operating flow range. Switches shall have snap-acting Form C contacts rated for the specific electrical application.

D. Humidity Sensors
   Sensors shall have an accuracy of ±25% over a range of 20% to 95% RH.

E. Current Sensing Relays
   Relays shall monitor status of motor loads. Switch shall have self-wiping, snap-acting Form C contacts rated for the application. The setpoint of the contact operation shall be field adjustable.

F. Output Relays
   Control relay contacts shall be rated for 150% of the loading application, with self-wiping, snap-acting Form C contacts, enclosed in dustproof enclosure. Relays shall have silver cadmium contacts with a minimum life span rating of one million operations. Relays shall be equipped with coil transient suppression devices.

G. Solid State Relays
   Input/output isolation shall be greater than 10 billion ohms with a breakdown voltage of 15 V root mean square, or greater, at 60 Hz. The contact operating life shall be 10 million operations or greater. The ambient temperature range of SSRs shall be 20□F-140□F. Input impedance shall be greater than 500 ohms. Relays shall be rated for the application. Operating and release time shall be 10 milliseconds or less. Transient suppression shall be provided as an integral part of the relays.

H. Valve and Damper Actuators
   1. Electronic Direct-Coupled: Electronic direct-coupled actuation shall be provided.
   2. Actuator Mounting: The actuator shall be direct-coupled over the shaft, enabling it to be mounted directly to the damper shaft without the need for connecting linkage. The fastening clamp assemble shall be of a 'V' bolt design with associated 'V' shaped toothed cradle attaching to the shaft for maximum strength and eliminating slippage. Spring return actuators shall have a 'V' clamp assembly of sufficient size to be directly mounted to an integral jackshaft of up to 1.05 inches when the damper is constructed in this manner. Single bolt or screw type fasteners are not acceptable

3. Electronic Overload Sensing: The actuator shall have electronic overload or digital rotation sensing circuitry to prevent damage to the actuator throughout the entire rotation of the actuator. Mechanical end switches or magnetic clutch to deactivate the actuator at the end of rotation are not acceptable.
4. Power Failure/Safety Applications: For power failure/safety applications, an internal mechanical spring return mechanism shall be built into the actuator housing. Non-mechanical forms of fail-safe operation are not acceptable.
5. Spring Return Actuators: All spring return actuators shall be capable of both clockwise or counterclockwise spring return operation by simply changing the mounting orientation.
6. Proportional Actuators: Proportional actuators shall accept a 0 to 10VDC or 0 to 20mA control input and provide a 2 to 10VDC or 4 to 20mA operating range. An actuator capable of accepting a pulse width modulating control signal and providing full proportional operation of the damper is acceptable. All actuators shall provide a 2 to 10VDC position feedback signal.
7. 24 Volts (AC/DC) actuators: All 24VAC/DC actuators shall operate on Class 2 wiring and shall not require more than 10VA for AC or more than 8 watts for DC applications. Actuators operating on 120VAC power shall not require more than 10VA. Actuators operating on 230VAC shall not require more than 11VA.
8. Non-Spring Return Actuators: All non-spring return actuators shall have an external manual gear release to allow manual positioning of the damper when the actuator is not powered. Spring return actuators with more than 60 in-lb torque shall have a manual crank for this purpose.
9. Modulating Actuators: All modulating actuators shall have an external, built-in switch to allow reversing direction of rotation.
10. Conduit Fitting & Pre-Wiring: Actuators shall be provided with a conduit fitting and a minimum 3ft electrical cable, and shall be pre-wired to eliminate the necessity of opening the actuator housing to make electrical connections.
11. U.L. Listing: Actuators shall be Underwriters Laboratories Standard 873 listed and Canadian Standards Association Class 4813 02 certified as meeting correct safety requirements and recognized industry standards.

I. Control Valves

Provide factory fabricated U.S. forged and assembled electric control valves of type, body material, and pressure class indicated. Where type or body material is not indicated, provide selection as determined by manufacturer for installation requirements and pressure class, based on maximum pressure and temperature in piping system. Provide valve size in accordance with scheduled or specified maximum pressure drop across control valve. Except as otherwise indicated, provide valves which mate and match material of connecting piping. Equip control valves with control valve motor actuators, with proper shutoff rating for each individual application.

1. Water Service Valves: Equal percentage characteristics with rangeability of 50 to 1, Class 150 at 250°F and maximum full flow pressure drop 5 psig. Globe type with replaceable plugs and seats of stainless steel or brass. Select operators to close valves against pump shutoff head.
2. Steam Service Valves: Linear characteristics with rangeability to 30 to 1, and maximum full flow pressure drop of 80% of inlet pressure for low pressure

systems, and 42% for high pressure. Class 150 at 250°F valve with replaceable plugs and seats of stainless steel.

3. Double Seated Valves: Balanced plug type, with caged type trim providing seating and guiding surfaces on "top and bottom" guided plugs.
4. Valve Trim and Stems: Polished stainless steel.
5. Packing: Spring-loaded teflon, self-adjusting.
6. Terminal Unit Control Valves: Provide control ball valves for control of terminal units including, but not necessarily limited to, convectors, thinned tube radiation, and fan coil - units that are of integral motor type. Provide 2-position or modulating type valves, electrically actuated by line voltage or by 24VAC.

J. Control Dampers

Provide automatic control low leakage, opposed blade dampers, with damper frames not less than formed 13-gauged galvanized steel. Provide mounting holes for enclosed duct mounting. Provide damper blades not less than formed 16-gauged galvanized steel, with maximum blade width of 8-inch. Equip dampers with motors of proper rating of each application.

1. Secure blades to ½ inch diameter zinc-plated axles using zinc-plated hardware. Seal off against spring stainless steel blade bearings. Provide blade bearings Nylon and provide thrust bearings at each end of every blade. Construct blade linkage hardware of zinc-plated steel and brass. Submit leakage and flow characteristics plus size schedule for controlled dampers.
2. Operating Temperature Range: From –20° to 200°F (-29° to 93°C).
3. For low leakage application or opposed blade design (as selected by manufacturers sizing techniques) with inflatable steel blade edging or replaceable rubber seals, rated for leakage less than 10 cfm per square foot of damper area, AR differential pressure of 4-inch w.g. when damper is being held by torque 50 inch-pounds.
4. Provide unit ventilator outside air dampers with adjustable minimum settings so that ventilation can be adjusted for each space or room.

PART 4 – DDC SOFTWARE

4.01 OVERVIEW

The system shall continuously perform Direct Digital Control (DDC) functions at the local control module in a stand-alone mode. The operator shall be able to design and modify the control loops to meet the requirements of the system being operated. The operators shall use system provided displays for tuning of PID loops. These displays shall include the past three input variable values, the setpoint for the loop as well as the sample interval and the results of the proportional, integral and derivative effects on the final output.

A. Minimum Function

Each control module shall perform the following functions:

1. Identify and report alarm conditions
2. Execute all application programs indicated on the I/O Summary table
3. Execute DDC algorithms

4. Trend and store data

B. Control Failure Mode
In the event of a control module failure, all points under its control shall be commanded to the failure mode as indicated on the I/O Summary Table. All DDC software shall reside in the respective control module.
1. Orderly Shutdown: Power failures shall cause the control module to go into an orderly shutdown with no loss of program memory.
2. Automatic Restart: Upon resumption of power, the control module shall automatically restart and print out the time and date of the power failure and restoration at the respective Workstation system.
3. Automatic Restart: The restart program shall automatically restart affected field equipment. The operator shall be able to define an automatic power up time delay for each piece of equipment under control.

PART 5 – APPLICATIONS SOFTWARE

5.01 GENERAL

The following applications software shall be provided for the purpose of optimizing energy consumption while maintaining occupant comfort:

A. Time of Day Scheduling (TOD)
The system shall be capable of the following scheduling features:
1. Schedule by Type. Scheduling by building, area, zone, groups of zones, individually controlled equipment and groups of individually controlled equipment. Each schedule shall provide beginning and ending dates and times (hours: minutes). A weekly repeating schedule, i.e. between 8:00 a.m. and 5:00 p.m., Monday through Friday shall constitute one schedule, not five.
2. Schedule in Advance. Dated schedules shall be entered up to nine (9) years in advance.
3. Self-Deleting. Schedules shall be self-deleting when effective dates have passed.
4. Leap Year. Leap years shall be adjusted automatically without operator intervention.

B. Optimum Start/Stop (OSS)/Optimum Enable/Disable (OED)
This application provides software to start and stop equipment on a sliding schedule based on the individual zone temperature and the heating/cooling capacity in °F/hour of the equipment serving that zone. The heating/cooling capacity value shall be operator adjustable. Temperature compensated peak demand limiting shall remain in effect during morning start up to avoid setting a demand peak.

C. Source Temperature Optimization (STO)
The system shall automatically perform source optimization for all air handling units, chillers and boilers in response to the needs of other downstream pieces of equipment, by increasing or decreasing supply temperature setpoints, i.e. chilled water, discharge air, etc. using owner defined parameters. In addition to optimization, the STO capability shall also provide for starting and stopping primary mechanical equipment based on zone occupancy and/or zone load conditions.

D. Demand Limiting (DL) - Temperature Compensated
The DL application shall be programmable for a minimum of six separate time of day KW demand billing rate periods. The system shall be capable of measuring electrical usage from multiple meters serving one building and each piece of equipment being controlled on the LAN shall be programmable to respond to the peak demand information from its respective meter.
1. Sliding Window: The demand control function shall utilize a sliding window method with the operator being able to establish the kilowatt threshold for a minimum of three adjustable demand levels. The sliding window interval shall be operator selectable in increments of one minute, up to 60 minutes. Systems that incorporate rotating shed tables will not be acceptable.
2. Setpoints for Defined Demand Level: The operator shall have the capability to set the individual equipment temperature setpoints for each operator defined demand level. Equipment shall not be shed if these reset setpoints are not satisfied; rather the setpoint shall be revised for the different established demand levels. The system shall have failed meter protection, such that when a KW pulse is not received from the utility within an operator adjustable time period, an alarm will be generated. The system software will automatically default to a predetermined fail-safe shed level.
3. Information Archiving: The system shall have the ability to archive demand and usage information for use at a later time. System shall permit the operator access to this information on a current day, month to date and a year to date basis.

E. Day/Night Setback (DNS)
The system shall allow the space temperature to drift down [up] within a preset [adjustable] unoccupied temperature range. The heating [cooling] shall be activated upon reaching either end of the DNS range and shall remain activated until the space temperature returns to the DNS range.

F. Timed Local Override (TLO)
The system shall have TLO input points that permit the occupants to request an override of equipment that has been scheduled OFF. The system shall turn the equipment ON upon receiving a request from the local input device. Local input devices shall be push button (momentary contact), wind-up timer, or ON/OFF switches as detailed in the I/O summary.

G. Space Temperature Control (STC)
There shall be two space temperature setpoints, one for cooling and one for heating, separated by a dead band. Only one of the two setpoints shall be operative at any time. The cooling setpoint is operative if the actual space temperature has more recently been equal to or greater than the cooling setpoint. The heating setpoint is operative if the actual space temperature has more recently been equal to or less than the heating setpoint. There are two modes of operation for the setpoints, one for the occupied mode (example: heating = 72°F or 22°C, cooling = 76°F or 24.4°C) and one for the unoccupied mode (example: heating = 55°F or 12.7°C, cooling = 90°F or 32°C).
1. Schedule: The occupied/unoccupied modes may be scheduled by time, date, or day of week.
2. Color Code: One of seven colors shall be generated to represent the comfort conditions in the space, and shall be displayed graphically at the operator station.

a. If the actual space temperature is in the dead band between the heating setpoint and the cooling setpoint, the color displayed shall be green for the occupied mode, representing ideal comfort conditions. If in the unoccupied mode, the color displayed shall be gray representing 'after-hours' conditions.
b. If the space temperature rises above the cooling setpoint, the color shall change to yellow. Upon further rise beyond the cooling setpoint plus an offset, the color shall change to orange. Upon further rise beyond the cooling setpoint plus the yellow band offset, plus the orange band offset, the color shall change to red indicating unacceptable high temperature conditions. At this point an alarm shall be generated to notify the operator.
c. When space temperature falls below the heating setpoint, the color shall change to light blue. Upon further temperature decrease below the heating setpoint minus an offset, the color shall change to dark blue. Upon further space temperature decrease below the heating setpoint minus the light blue band offset minus the dark blue band offset the color shall change to red indicating unacceptable low temperature conditions. At this point an alarm shall be generated to notify the operator.

3. Operator Definable: All setpoints and offsets shall be operator definable. When in the occupied mode, start-up mode, or when heating or cooling during the night setback unoccupied mode, a request shall be sent over the network to other equipment in the HVAC chain, such as to an AHU fan that serves the space, to run for ventilation. The operator shall be able to disable this request function if desired.
4. Additional Cooling: When comfort conditions are warmer than ideal, indicated by the colors yellow, orange, and high temperature red, a request for additional cooling shall be sent over the network to other cooling equipment in the HVAC chain, such as a chiller. This information is to be used for optimization of equipment in the HVAC chain. The operator shall be able to disable this function if desired.
5. Additional Heating: When comfort conditions are cooler than ideal; indicated by the colors light blue, dark blue, and low temperature red; a request for additional heating shall be sent over the network to other heating equipment in the HVAC chain, such as a boiler. This information is to be used for optimization of equipment in the HVAC chain. The operator shall be able to disable this function if desired.
6. Cooling/Heating Setpoints: The cooling [and heating] setpoints may be increased [decreased] under demand control conditions to reduce the cooling (heating) load on the building during the demand control period. Up to three levels of demand control strategy shall be provided. The operator may predefine the amount of setpoint increase [decrease] for each of the three levels. Each space temperature sensor in the building may be programmed independently.
7. Optimum Start: An optimum start-up program transitions from the unoccupied setpoints to the occupied setpoints. The optimum start-up algorithm considers the rate of space temperature rise for heating and the rate of space temperature fall for cooling under nominal outside temperature conditions; it also considers the outside temperature; and the heat loss and gain coefficients of the space envelope (AI: Space Temperature).

8. PID Loop: A PID control loop, comparing the actual space temperature to its setpoint, shall modulate the dampers [and heating coil valve or heating stages in sequence] to achieve the setpoint target.

PART 6 - EXECUTION

6.01 HARDWARE INSTALLATION

A. Utility Company Equipment
Owner shall arrange installation of electric billing meters, water meters, and gas meters with demand signal pulses, as indicated.

B. Wiring
1. The Contractor shall install wires for the room temperature sensors (from sensor to the appropriate control module).
2. The Contractor shall install all sensing devices and the wiring to modules.
3. The Contractor shall install all control and monitoring wiring in Mechanical Room.
4. Low voltage wire shall be not less than 18 AWG. All line voltage wire shall be THHN/TFFN, 600 volt rated.
5. Control and interlock wiring and installation shall comply with national and local electrical codes, Division 16, and manufacturer's recommendations.
6. NEC Class 1 (line voltage) wiring shall be UL listed in approved raceway as specified by NEC and Division 16.
7. Low-voltage wiring shall meet NEC Class 2 requirements. Subfuse low-voltage power circuits as required to meet Class 2 current limit.
8. NEC Class 2 (current-limited) wires not in raceway but in concealed and accessible locations such as return air plenums shall be UL listed for the intended application.
9. Install wiring in raceway where subject to mechanical damage and all exposed locations such as mechanical, electrical, or service rooms.
10. Install Class 1 and Class 2 wiring in separate raceways. Boxes and panels containing high-voltage wiring and equipment shall not be used for low-voltage wiring except for the purpose of interfacing the two through relays and transformers.
11. Run exposed Class 2 wiring parallel to a surface or perpendicular to it and tie neatly at 2 m (6 ft) intervals.
12. Use structural members to support or anchor plenum cables without raceway. Do not use ductwork, electrical raceways, piping, or ceiling suspension systems to support or anchor cables.
13. Secure raceways with raceway clamps fastened to structure and spaced according to code requirements. Raceways and pull boxes shall not be hung on or attached to ductwork, electrical raceways, piping, or ceiling suspension systems.
14. Size raceway and select wire size and type in accordance with manufacturer's recommendations and NEC requirements.
15. Include one pull string in each raceway 2.5 cm (1 in.) or larger.
16. Use color-coded conductors throughout.

17. Conceal raceways except within mechanical, electrical, or service rooms. Maintain minimum clearance of 15 cm (6 in.) between raceway and high-temperature equipment such as steam pipes or flues.
18. Adhere to requirements in Division 16 where raceway crosses building expansion joints.
19. Install insulated bushings on raceway ends and enclosure openings. Seal top ends of vertical raceways.
20. Terminate control and interlock wiring related to the work of this section. Maintain at the job site updated (as-built) wiring diagrams that identify terminations.
21. Flexible metal raceways and liquid-tight flexible metal raceways shall not exceed 1 m (18") in length and shall be supported at each end. Do not use flexible metal raceway less than ½ in. electrical trade size. Use liquid-tight flexible metal raceways in areas exposed to moisture including chiller and boiler rooms.
22. Install raceway rigidly, support adequately, ream at both ends, and leave clean and free of obstructions. Join raceway sections with couplings and according to code. Make terminations in boxes with fittings. Make terminations not in boxes with bushings.
23. Communication wiring shall be low-voltage Class 2 wiring and shall comply with Article 3.7 (Wiring).
24. Install communication wiring in separate raceways and enclosures from other Class 2 wiring.
25. During installation do not exceed maximum cable pulling, tension, or bend radius specified by the cable manufacturer.
26. Verify entire network's integrity following cable installation using appropriate tests for each cable.
27. Install lightning arrestor according to manufacturer's recommendations between cable and ground where a cable enters or exits a building.
28. Each run of communication wiring shall be a continuous length without splices when that length is commercially available. Runs longer than commercially available lengths shall have as few splices as possible using commercially available lengths.
29. Label communication wiring to indicate origination and destination.
30. Ground coaxial cable according to NEC regulations article on "Communications Circuits, Cable, and Protector Grounding."

6.02 SMOKE DETECTORS

A. Smoke detectors approved for duct installation shall be provided by Division 16 for all air systems of 2000 cfm capacity or above or as indicated on the drawings, to automatically shut down the supply fan and close all smoke dampers (as required). Each detector shall have an integral relay.

B. Smoke detectors shall be furnished by Division 16000 and installed under Division 15000. All wiring between detector and fire alarm system shall be provided and installed under Division 16000.

6.03 VALVES

Control valves shall be electric operated. Actuators shall be mounted vertically above piping served or horizontally, no lower than the center line of the piping. Surrounding piping and equipment shall be located and valve location in piping shall be such that a minimum service clearance of 6" (or greater as required by the manufacturer's recommendations) is provided between the top of the valve actuator and the obstruction to facilitate maintenance and removal of actuator.

6.04 CONTROL PANELS

Furnish formed sheet metal control panels as required with locking door and hinges. All necessary relays, switches and peripheral devices shall be located inside panels. All multi-equipment main panels shall have a laminated control point diagram identifying all control points and monitoring points associated with the control module(s) contained within the panel. Each panel shall be identified with an attached identifying phenolic tag. All electric devices shall be connected to numbered terminal strips. All control panels shall be centrally located.

6.05 SEQUENCE OF OPERATION

A. Chilled water cooling system:
   1. At the start of the occupied periods and at outdoor temperatures above 55 deg. F (adjustable) the BAS shall start the chilled water pump and during the occupied periods the pump shall run continuously. At the end of the occupied periods the BAS shall stop the chilled water pump except that the pump shall run whenever any override interval timer or night set-up temperature sensor in the building is activated. Should the active pump fail, the BAS shall send an alarm to the central site computer.
   2. The differential pressure set point shall be reset down, until the chilled water valve with most cooling demand is nearly wide open.
   3. Upon proof of chilled water flow, as sensed by a differential pressure sensor across the chilled water piping entering and leaving the chiller evaporator, in conjunction with an electrical interlock with the chilled water pump starter, the BAS shall enable chiller. At the end of the occupied periods the chiller shall cycle off according to the factory preset controls and the control valves in the chilled water supply piping from each chiller shall close.
   4. During chiller operation, the controls provided with chiller shall maintain a chilled water supply temperature, adjusted in inverse proportion to outdoor temperature as follows. A chilled water supply temperature of 42 deg. F shall be maintained at outdoor temperatures of 80 deg. F and above. As the outdoor temperature drops below 80 deg. F the supply water temperature shall be reset upward until, at an outdoor temperature of 50 deg. F, chilled water supply temperature shall be maintained at 50 deg. F, all adjustable. The reset schedule shall be displayed and shall be adjustable by the BAS operator.
   5. During chiller operation the BAS shall continually monitor the following:
      a. Primary chilled water pump status.
      b. All status points available at chiller. Provide an interface module to be compatible with the BAS in order to obtain the status points.
      c. Position of control valve V-1 leaving chiller CH-1.
      d. Common chilled water supply temperature.

e. Common chilled water return temperature.

B. Heating System:
1. The BAS shall start and stop hot water pump and during the occupied periods the pump shall run continuously any time outdoor temperature is below 65 degrees F (adjustable). Upon proof of water flow, as sensed by a flow switch in the hot water supply piping leaving the pump, in conjunction with an electrical interlock with the pump starter, the BAS shall enable boiler B-1. The boiler shall operate and cycle on its factory preset operating and safety controls.
2. The boiler control panel shall modulate the boiler firing to maintain a hot water supply temperature in inverse proportion to outdoor air temperature as follows. Hot water supply temperature shall be 135 degrees F at an outdoor temperature of 75 degrees F and above and hot water supply temperature shall be 170 degrees F at an outdoor temperature of 10 degrees F and below, all adjustable.
3. The BAS shall alternate the operation of hot water pumps on a schedule approved by the Owner to equalize run time. Should the active pump fail, the BAS shall immediately start the standby pump,
4. During the unoccupied periods pump shall stop, boiler B-1 shall cycle off according to its factory preset controls.
5. During the unoccupied periods, anytime space temperature drops below 50 degrees F (adjustable) as sensed by any a night set-back temperature sensor pumps and boiler B-1 shall run as described above to maintain normal occupied hot water supply temperatures.
6. The boiler low water cut-off (LWCO) shall alarm the central site computer if the boiler water level drops below its predetermined low level.
7. During boiler operation the BAS shall continually monitor the following:
   a. Hot water supply temperature.
   b. Hot water return temperature.
   c. Boiler forced draft fan status.
   d. Hot water pump status.

C. Air handling units (AHU-0, 1, 2, 3 & 4):
1. The BAS shall start and stop air handling units and during the occupied periods the fan shall run continuously. When the fan starts the air handling unit return air damper shall open and the outdoor air damper shall open to its minimum position. When the fan stops all dampers shall close. Any local override timer in this system shall override the BAS during the unoccupied periods to place the system in its normal operating mode. Any local night set-back temperature sensor in this system shall override the BAS during the unoccupied periods to place the system in its set-back mode.
2. The supply fan variable frequency speed controller shall be under the control of a duct mounted static pressure sensor located approximately 2/3 the distance down the primary supply ductwork. The set-point of the sensor shall be adjusted in the field so as to maintain a duct static pressure near the air handling unit discharge of approximately 2.5" w.g.
3. The duct static pressure set point, 2.5" w.g., shall be reset down, thru the DDC system, based on the zone requiring the most pressure, until the zone damper is nearly wide open.
4. A duct mounted over-pressure sensor, located in the discharge duct and upstream of the first fire damper or fire/smoke damper in the system shall shut down fan operation if

the static pressure exceeds 4" w.g. (adjustable).

5. The outdoor air and return air dampers shall be under the control of a dry bulb economizer during the occupied periods. When the outdoor air temperature drops below 50 deg. F (adjustable) and there is still a demand for cooling, the outdoor air damper shall begin to open beyond its minimum position and the return air damper shall begin to close as required to satisfy a discharge air temperature sensor set at 52 deg. F (adjustable). When all demand for cooling has ended the dampers shall return to their normal positions as described above.
6. When the air handling unit supply fan starts, the BAS shall enable return fan RF-1, 2 or 3. The return fans motor shall be under the control of a variable frequency speed controller to maintain building pressurization in the respective floor it serves with respect to the outdoors. When the air handling unit supply fan starts, the respective return fan (RF-2 and 3) shall start and the motor speed shall ramp up until a slight positive pressure in the building exists (set-point to be adjusted in the field). As the pressure in the building starts to fall below the set-point the fan motor shall slow down and as the pressure in the building starts to rise above the set-point the fan motor shall speed up. When the air handling unit fan stops, the return fan shall be disabled.
7. A firestat, set at 125 deg. F and located at the inlet to the air handling unit, and a smoke detector located in the supply duct downstream of the air handling unit, shall shut down the supply fan operation and alarm the central site computer should temperature exceed the set-point or if smoke is detected.
8. A freezestat, set at 35 deg. F and located just upstream of the chilled water coil shall shut down fan operation, close the outdoor air damper and alarm the central site computer should the temperature drop below the set-point.
9. A temperature sensor located just downstream of the hot water preheat coil shall modulate the 3-way hot water valve to maintain a discharge air temperature set-point of 52 deg. F (adjustable).
10. During fan operation the chilled water coil three-way control valve shall modulate open to the coil as required to satisfy a discharge air temperature sensor in the supply duct just downstream of the air handling unit. The set-point shall be 52 deg. F (adjustable).
11. During fan operation and only at outdoor air temperatures above 50 deg. F (adjustable) the system shall be under the control of a space humidity sensor. Anytime space relative humidity rises above the set-point of 55% RH (adjustable) the chilled water coil three-way control valve shall open 100% to the coil and when space relative humidity drops below 50% the system shall revert to its normal space temperature control. During dehumidification the hot water coil in each VAV terminal box shall modulate the 3-way control valve as required to maintain the space cooling set-point temperature in each zone.
12. During the unoccupied periods, anytime space temperature drops below 50 degrees F (adjustable) as sensed by any a night set-back temperature sensor, the respective air handling unit supply fan shall start, the respective return fan shall be enable, and the outside air damper shall remain closed. The 3-way hot water valve shall fully open to the coil. Once the return air temperature rises above the night set back temperature, the air handling unit shall be disable.
13. The VAV terminal units and PIUs boxes associated with each air handling unit shall all operate the same as follows. Their respective room temperature sensor shall modulate the primary air damper, activate the box blower and modulate the 3-way hot water valve in sequence to maintain set-point temperature. On a rise in space

temperature above 74 deg. F (adjustable) the primary air damper shall modulate open. On a drop in space temperature below 72 deg. F (adjustable) the primary air damper shall modulate closed to its minimum position. Upon a further drop in space temperature below 71 deg. F (adjustable) the box blower shall start. Upon a continued drop in space temperature below 70 deg. F (adjustable) the 3-way hot water control valve modulate to maintain set-point temperature.

14. During fan operation the BAS shall continually monitor the following:
    a. Air Handling Unit supply fan status.
    b. Air Handling Unit fan speed.
    c. Return Fan status.
    d. Return Fan speed.
    e. Position of the outdoor air and return air dampers.
    f. Mixed air temperature.
    g. Discharge air temperature leaving the air handling unit.
    h. Outdoor air temperature.
    i. Space relative humidity.
15. The outdoor air and return air dampers shall modulate to maintain design outside air level when in occupied mode and when economizer function is disabled based on mixed air static pressure. Damper positions shall be set during test and balance at supply air points 25%, 50%, 75% and 100% of design air flow. Dampers shall adjust in linear control between balance points as supply air flow changes.

G. Exhaust fans EF-1
    1. The BAS shall energize the fan on a time schedule. During the occupied mode, the fan shall run continuously, during the unoccupied mode, the fan shall be off.

SECTION 23 73 13 - MODULAR INDOOR AIR-HANDLING UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes constant-volume, modular air-handling units with coils for indoor installations.

1.3 SUBMITTALS

A. Product Data: For each type of modular indoor air-handling unit indicated. Include the following:

1. Certified fan-performance curves with system operating conditions indicated.
2. Certified fan-sound power ratings.
3. Certified coil-performance ratings with system operating conditions indicated.
4. Motor ratings, electrical characteristics, and motor and fan accessories.
5. Material gages and finishes.
6. Filters with performance characteristics.
7. Dampers, including housings, linkages, and operators.

B. Shop Drawings: Signed and sealed by a qualified professional engineer.

1. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, and base weights.
3. Wiring Diagrams: Power, signal, and control wiring.

C. Coordination Drawings: Submit with Shop Drawings. Show mechanical-room layout and relationships between components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate and certify field measurements.

D. Field Quality-Control Test Reports: From manufacturer.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain modular indoor air-handling units through one source from a single manufacturer.

B. Product Options: Drawings indicate size, profiles, and dimensional requirements of modular indoor air-handling units and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. NFPA Compliance: Modular indoor air-handling units and components shall be designed, fabricated, and installed in compliance with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."

E. ARI Certification: Modular indoor air-handling units and their components shall be factory tested according to ARI 430, "Central-Station Air-Handling Units," and shall be listed and labeled by ARI.

F. Comply with NFPA 70.

1.5 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 7 Section "Roof Accessories."

C. Coordinate size and location of structural-steel support members.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Trane Company (The); Worldwide Applied Systems Group.
   2. Daikin Global
   3. Johnson Controls Corporation.

2.2 MANUFACTURED UNITS

A. Modular indoor air-handling units shall be factory assembled and consist of fans, motor and drive assembly, coils, damper, plenums, filters, condensate pans, mixing dampers, control devices, and accessories.

2.3 CABINET

A. Materials: Formed and reinforced single-wall insulated panels, fabricated to allow removal for access to internal parts and components, with joints between sections sealed.

1. Outside Casing: Steel, 0.0598 inch thick.
2. Floor Plate: Stainless steel, 0.1406 inch thick.

B. Cabinet Insulation: Comply with NFPA 90A or NFPA 90B.

1. Materials: ASTM C 1071 with coated surface exposed to airstream to prevent erosion of glass fibers.
2. Thickness: 1-1/2 inches.
3. Thermal Conductivity (k-Value): 0.26 at 75 deg F mean temperature.
4. Fire-Hazard Classification: Maximum flame-spread index of 25 and smoke-developed index of 50, when tested according to ASTM C 411.
5. Liner Adhesive: Comply with NFPA 90A or NFPA 90B and ASTM C 916.
6. Mechanical Fasteners: Galvanized steel, suitable for adhesive attachment, mechanical attachment, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in cabinet.
7. Location and Application: Factory applied with adhesive and mechanical fasteners to the internal surface of section panels downstream from and including the cooling coil section.
8. Location and Application: Encased between outside and inside casing.

C. Access Panels and Doors: Same materials and finishes as cabinet, complete with hinges, latches, handles, and gaskets. Inspection and access panels and doors shall be sized and located to allow periodic maintenance and inspections. Provide access panels and doors in the following locations:

1. Fan Section: Doors.
2. Access Section: Doors.
3. Coil Section: Inspection panel.
4. Damper Section: Doors.
5. Filter Section: Doors to allow periodic removal and installation of filters.

D. Condensate Drain Pans: Formed sections of stainless-steel sheet complying with requirements in ASHRAE 62. Fabricate pans with slopes in two planes to collect condensate from cooling coils (including coil piping connections and return bends) and humidifiers when units are operating at maximum catalogued face velocity across cooling coil.

1. Double-Wall Construction: Fill space between walls with foam insulation and seal moisture tight.

2. Drain Connections: Both ends of pan.
3. Pan-Top Surface Coating: Elastomeric compound.
4. Units with stacked coils shall have an intermediate drain pan or drain trough to collect condensate from top coil.

2.4 FAN SECTION

A. Fan-Section Construction: Belt-driven axial fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, and support structure and equipped with formed-steel channel base for integral mounting of fan, motor, and casing panels. Mount fan with vibration isolation.

B. Centrifugal Fan Housings: Formed- and reinforced-steel panels to make curved scroll housings with shaped cutoff, spun-metal inlet bell, and access doors or panels to allow entry to internal parts and components.

1. Panel Bracing: Steel angle- or channel-iron member supports for mounting and supporting fan scroll, wheel, motor, and accessories.
2. Horizontal Flanged Split Housing: Bolted construction.
3. Plug Fans: With steel cabinet. Fabricate without fan scroll and volute housing.

C. Fan Assemblies: Statically and dynamically balanced and designed for continuous operation at maximum rated fan speed and motor horsepower.

D. Backward-Inclined Fan Wheels: Aluminum construction with curved inlet flange, backplate, and backward-inclined blades welded or riveted to flange and backplate; cast-iron or cast-steel hub riveted to backplate and fastened to shaft with set screws.

E. Forward-Curved Fan Wheels: Black-enamel or galvanized-steel construction with inlet flange, backplate, and shallow blades with inlet and tip curved forward in direction of airflow and mechanically secured to flange and backplate; cast-steel hub swaged to backplate and fastened to shaft with set screws.

F. Airfoil-Fan Wheels: Steel construction with smooth-curved inlet flange, heavy backplate, and hollow die-formed airfoil-shaped blades continuously welded at tip flange and backplate; cast-iron or cast-steel hub riveted to backplate and fastened to shaft with set screws.

G. Axial-Fan Wheels: Cast aluminum, with airfoil-shaped blades mounted on cast-iron wheel plate keyed to shaft with solid-steel key.

1. Fan Hub and Blade-Bearing Assemblies: Cast aluminum, machined and fitted with threaded bearing wells to receive blade-bearing assemblies.
2. Blades: Replaceable, cast aluminum; factory mounted and balanced to hub assembly.
3. Fan Shaft: Turned, ground, and polished steel designed to operate at no more than 70 percent of first critical speed at top of fan's speed range.

H. Shafts: Statically and dynamically balanced and designed for continuous operation at maximum rated fan speed and motor horsepower, with final alignment and belt adjustment made after installation.

1. Turned, ground, and polished hot-rolled steel with keyway. Ship with a protective coating of lubricating oil.
2. Designed to operate at no more than 70 percent of first critical speed at top of fan's speed range.

I. Prelubricated and Sealed Shaft Bearings: Self-aligning, pillow-block-type ball bearings.

1. Ball-Bearing Rating Life: ABMA 9, L_{10} of 120,000 hours.

J. Grease-Lubricated Shaft Bearings: Self-aligning, pillow-block-type, tapered roller bearings with double-locking collars and two-piece, cast-iron housing.

1. Roller-Bearing Rating Life: ABMA 11, L_{10} of 120,000 hours.

K. Grease-Lubricated Shaft Bearings: Self-aligning, pillow-block-type, ball or roller bearings with adapter mount and two-piece, cast-iron housing.

1. Ball-Bearing Rating Life: ABMA 9, L_{10} of 120,000 hours.
2. Roller-Bearing Rating Life: ABMA 11, L_{10} of 120,000 hours.

L. Belt Drives: Factory mounted, with final alignment and belt adjustment made after installation and with 1.5] service factor based on fan motor.

1. Pulleys: Cast iron or cast steel with split, tapered bushing; dynamically balanced at factory.
2. Motor Pulleys: Adjustable pitch for use with 5-hp motors and smaller; fixed pitch for use with motors larger than 5 hp. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.
3. Belts: Oil resistant, nonsparking, and nonstatic; matched for multiple belt drives.
4. Belt Guards: Fabricate to OSHA/SMACNA requirements; 0.1046-inch- thick, 3/4-inch diamond-mesh wire screen welded to steel angle frame or equivalent; prime coated. Provide belt guards for motors mounted on outside of cabinet.
5. Motor Mount: Adjustable for belt tensioning.

M. Discharge Dampers: Heavy-duty steel assembly with channel frame and sealed ball bearings, and opposed blades constructed of two plates formed around and welded to shaft, with blades linked out of airstream to single control lever.

N. Vibration Control: Install fans on open-spring vibration isolators having a minimum of 1-inch static deflection and side snubbers.

O. Fan-Section Source Quality Control:

1. Sound Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Fans shall bear AMCA-certified sound ratings seal.
2. Factory test fan performance for flow rate, pressure, power, air density, rotation speed, and efficiency. Establish ratings according to AMCA 210, "Laboratory Methods of Testing Fans for Rating."

2.5 MOTORS

A. General: Comply with requirements in Division 15 Section "Motors."

B. Noise Rating: Quiet.

2.6 COILS

A. Coil Sections: Common or individual, insulated, galvanized-steel casings for heating and cooling coils. Design and construct to facilitate removal and replacement of coil for maintenance and to ensure full airflow through coils.

B. Water Coils: Continuous circuit coil fabricated according to ARI 410.

1. Face-and-Bypass Dampers: Extruded-aluminum blades with full-length drive rod.

a. Arrangement: Horizontal coils.

2. Piping Connections: Threaded, on same end.
3. Tubes: Copper.
4. Fins: Aluminum with fin spacing 0.125 inch
5. Fin and Tube Joint: Mechanical bond
6. Headers: Cast iron with drain and air vent tappings].
7. Frames: Galvanized-steel channel frame, 0.052 inch
8. Frames: Stainless steel, 0.0625 inch.
9. Ratings: Design tested and rated according to ASHRAE 33 and ARI 410.

a. Working-Pressure Ratings: 200 psig, 325 deg F (163 deg C).

10. Source Quality Control: Test to 300 psig and to 200 psig underwater.

C. Refrigerant Coils (Heat Pipe Technologies): Coil designed for use with R-410a refrigerant, fabricated according to ARI 410, connected with [soldered] [brazed] fittings.

1. Capacity Reduction: Circuit for face control.
2. Tubes: Copper.
3. Fins: Aluminum with fin spacing 0.125 inch
4. Fin and Tube Joint: Mechanical bond
5. Suction and Distributor: Seamless copper tube with brazed joints.
6. Frames: Galvanized-steel channel frame, 0.052 inch
7. Frames: Stainless steel, 0.0625 inch.
8. Ratings: Design tested and rated according to ASHRAE 33 and ARI 410.

a. Working-Pressure Rating: 300 psig.

9. Source Quality Control: Test to 450 psig and to 300 psig underwater.

2.7 DAMPERS

A. General: Leakage rate, according to AMCA 500, "Laboratory Methods for Testing Dampers for Rating," shall not exceed 2 percent of air quantity at 2000-fpm face velocity through damper and 4-inch wg pressure differential.

B. Damper Operators: Pneumatic or Electric specified in Division 23 Section "HVAC Instrumentation and Controls."

C. Low-Leakage, Outside-Air Dampers: Double-skin, airfoil-blade galvanized-steel dampers with compressible jamb seals and extruded-vinyl blade edge seals, in opposed blade arrangement with steel operating rods rotating in stainless-steel sleeve bearings mounted in a single galvanized-steel frame, and with operating rods connected with a common linkage. Leakage rate shall not exceed 5 cfm/sq. ft. at 1-inch wg and 9 cfm/sq. ft. at 4-inch wg.

D. Mixing Boxes: Parallel-blade galvanized-steel dampers mechanically fastened to steel operating rod in reinforced, galvanized-steel cabinet. Connect operating rods with common linkage and interconnect linkages so dampers operate simultaneously.

E. Combination Filter and Mixing Box: Parallel-blade galvanized-steel dampers mechanically fastened to steel operating rod in reinforced, galvanized-steel cabinet. Connect operating rods with common linkage and interconnect linkages so dampers operate simultaneously. Cabinet support members shall hold 2-inch- thick, pleated, flat permanent or throwaway filters. Provide hinged access panels or doors to allow removal of filters from both sides of unit.

2.8 FILTER SECTION

A. Filters: Comply with NFPA 90A.

B. Filter Section: Provide filter holding frames arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side.

C. Disposable Panel Filters: Factory-fabricated, viscous-coated, flat-panel-type, disposable air filters with holding frames.

1. Media: Interlaced glass fibers sprayed with nonflammable adhesive.
2. Frame: Galvanized steel with metal grid on outlet side, steel rod grid on inlet side, hinged, and with pull and retaining handles.
3. Duct-Mounting Frames: Welded, galvanized steel with gaskets and fasteners, suitable for bolting together into built-up filter banks.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in of steam, hydronic, and condensate drainage piping systems and electrical services to verify actual locations of connections before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Concrete Bases: Install floor mounting units on 4-inch- high concrete bases. See Division 15 Section "Basic Mechanical Materials and Methods" for concrete base materials and fabrication requirements.

B. Install modular indoor air-handling units with the following vibration control devices. Vibration control devices are specified in Division 23 Section "Mechanical Vibration and Seismic Controls."

1. Units with Internally Isolated Fans: Secure units to anchor bolts installed in concrete bases.
2. Floor-Mounted Units: Support on concrete bases using neoprene pads. Secure units to anchor bolts installed in concrete bases.
3. Floor-Mounted Units: Support on concrete bases using housed-spring isolators. Secure units to anchor bolts installed in concrete bases.
4. Suspended Units: Suspend units from structural-steel support frame using threaded steel rods and spring hangers.

C. Arrange installation of units to provide access space around modular indoor air-handling units for service and maintenance.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to machine to allow service and maintenance.

C. Connect piping to modular indoor air-handling units mounted on vibration isolators with flexible connectors.

D. Connect condensate drain pans using NPS 1-1/4, Type M copper tubing. Extend to nearest equipment or floor drain. Construct deep trap at connection to drain pan and install cleanouts at changes in direction.

E. Hot- and Chilled-Water Piping: Comply with applicable requirements in Division 23 Section "Hydronic Piping." Connect to supply and return coil tappings with shutoff or balancing valve and union or flange at each connection.

F. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connections.

G. Electrical: Comply with applicable requirements in Division 26 Sections for power wiring, switches, and motor controls.

H. Ground equipment according to Division 26 Section "Grounding and Bonding."

I. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including piping and electrical connections. Report results in writing.

1. Leak Test: After installation, fill water and steam coils with water and test coils and connections for leaks. Repair leaks and retest until no leaks exist.
2. Charge refrigerant coils with refrigerant and test for leaks. Repair leaks and retest until no leaks exist.
3. Fan Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new units, and retest.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.5 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

B. Final Checks before Startup: Perform the following:

1. Verify that shipping, blocking, and bracing are removed.
2. Verify that unit is secure on mountings and supporting devices and that connections to piping, ducts, and electrical systems are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
3. Perform cleaning and adjusting specified in this Section.
4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify free fan wheel rotation and smooth bearing operations. Reconnect fan drive system, align belts, and install belt guards.
5. Lubricate bearings, pulleys, belts, and other moving parts with factory-recommended lubricants.
6. Set outside- and return-air mixing dampers to minimum outside-air setting.
7. Comb coil fins for parallel orientation.
8. Install clean filters.
9. Verify that manual and automatic volume control and fire and smoke dampers in connected duct systems are in fully open position.

C. Starting procedures for modular indoor air-handling units include the following:

1. Energize motor; verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated rpm. Replace fan and motor pulleys as required to achieve design conditions.
2. Measure and record motor electrical values for voltage and amperage.
3. Manually operate dampers from fully closed to fully open position and record fan performance.

D. Refer to Division 23 Section "Testing, Adjusting, and Balancing" for modular indoor air-handling system testing, adjusting, and balancing.

3.6 ADJUSTING

A. Adjust damper linkages for proper damper operation.

3.7 CLEANING

A. Clean modular indoor air-handling units internally, on completion of installation, according to manufacturer's written instructions. Clean fan interiors to remove foreign material and construction dirt and dust. Vacuum clean fan wheels, cabinets, and coils entering air face.

B. After completing system installation and testing, adjusting, and balancing modular indoor air-handling and air-distribution systems, clean filter housings and install new filters.

3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain modular indoor air-handling units. Refer to Division 1 Section "Closeout Procedures."

END OF SECTION 23 73 13

AIR DISTRIBUTION SCHEDULE

TAG	TITUS MODEL	FACE SIZE	NECK SIZE	MATERIAL	FRAME	FINISH	NOISE CRITERIA	NOTES
A	TMS–AA	24x24	–	ALUMINUM	LAY–IN	WHITE	30	1,2,3,4,9,10,11,13,14
B	TMS–AA	12x12	–	ALUMINUM	LAY–IN	WHITE	30	1,2,3,4,9,10,11,13,14
C	TMRA	18"ø	8"ø	ALUMINUM	–	WHITE	30	–
D	TMRA	22"ø	10"ø	ALUMINUM	–	WHITE	30	–
E	300FS	16x10	14x8	ALUMINUM	SIDEWALL	WHITE	30	1,2,3,5,11,15,17
F	ML–39	(2) 1" SLOTS @ 2' LONG		ALUMINUM	LINEAR	WHITE	30	1,2,3,8,11,18,19,20,21
AA	PAR–AA	24x24	–	ALUMINUM	LAY–IN	WHITE	30	1,2,3,11,12
BB	PAR–AA	12x12	–	ALUMINUM	LAY–IN	WHITE	30	1,2,3,11,12
CC	350FL	26x14	24x12	ALUMINUM	SIDEWALL	WHITE	30	1,2,3,6,11,12,16
DD	350FL	38x14	36x12	ALUMINUM	SIDEWALL	WHITE	30	1,2,3,6,11,12,16
EE	350FL	98x18	96x16	ALUMINUM	SIDEWALL	WHITE	30	1,2,3,6,11,12,16

TAG / CFM SUPPLY AIR DIFFUSER OR REGISTER

TAG / CFM RETURN/TRANSFER OR EXHAUST AIR GRILLE

NOTES:

1. APPROVED EQUAL MANUFACTURER: PRICE, CARNES, METALAIRE, NAILOR
2. FINAL COLOR SELECTION SUBJECT TO ARCHITECT APPROVAL
3. CONTRACTOR TO COORDINATE FINAL SELECTION WITH ARCHITECT AND OWNER. VERIFY CEILING SYSTEM FOR EXACT BORDER TYPE: I.E. STANDARD OR NARROW GRID.
4. SQUARE LOUVER FACE CEILING SUPPLY DIFFUSER
5. DOUBLE DEFLECTION SIDEWALL SUPPLY GRILLE
6. SIDEWALL RETURN GRILLE
7. SIGHT–PROOF, DOUBLE FLANGED TELESCOPIC DOOR GRILLE
8. LINEAR CEILING DIFFUSER WITH ADJUSTABLE DEFLECTION VANES BEHIND EACH SLOT
9. PROVIDE SPIN–IN COLLAR WITH VOLUME DAMPER AT TRUNK TO FLEX DUCT CONNECTION
10. PROVIDE TYPICAL 4–WAY DIFFUSION, 2–WAY, 3–WAY OR VERTICAL ONLY WHERE INDICATED ON PLANS.
11. PROVIDE STEEL RADIAL OPPOSED BLADE VOLUME DAMPER
12. PROVIDE VOLUME CONTROL DAMPERS FOR ALL RETURN GRILLES OR REGISTERS FOR BALANCED AIRFLOW. NOT REQUIRED IN TRANSFER.
13. FLEX DUCT SIZE TO BE SAME AS DIFFUSER NECK SIZE.
14. ROUND NECK OR PROVIDE SQUARE–TO–ROUND ADAPTER
15. FRONT BLADES PARALLEL TO SHORT DIMENSION
16. BLADES PARALLEL TO LONG (HORIZONTAL) DIMENSION, FIXED AT 35°
17. HORIZONTAL BLADES SET AT 22° ANGLE
18. CONCEALED FASTENING – NO SCREW HOLES
19. PROVIDE STRAIGHTENING VANES
20. PROVIDE END FRAME, ALIGNMENT STRIPS AND TITUS MP–39 PLENUMS. INSULATE PLENUMS WITH R–6 INSULATION
21. PROVIDE MITERED CORNERS FOR LINEAR DIFFUSERS
22. PROVIDE YOUNG REGULATOR FOR DIFFUSERS ABOVE HARD CEILING

				S/A FLEX SCHEDULE	
NECK SIZE	CFM RANGE	NECK SIZE	CFM RANGE	6ø"	50–125 CFM
6x6	0–200 CFM	14x14	0–1030 CFM	8ø"	130–200 CFM
8x8	0–350 CFM	16x16	0–1300 CFM	10ø"	205–330 CFM
10x10	0–540 CFM	18x18	0–1600 CFM	12ø"	335–450 CFM
12x12	0–780 CFM	22x22	0–2300 CFM	14ø"	455–700 CFM

MECHANICAL NOTES

1. THE CONTRACTOR SHALL FURNISH ALL LABOR, MATERIALS, AND EQUIPMENT NECESSARY FOR THE INSTALLATION OF A COMPLETE SYSTEM IN ACCORDANCE WITH THESE DRAWINGS, THE INTERNATIONAL BUILDING CODE 2012 AND ALL OTHER APPLICABLE STATE, COUNTY AND LOCAL ORDINANCES AND THE LATEST ADDITION OF THE FOLLOWING PUBLICATIONS; SMACNA–S5, 92, 95; ASHRAE 15–01, 34–01, 62.1; NFPA 70–02, 72–02, 90A–02, 90B–02, 91–99, 96–01; ANSI Z10.1–95, Z10.3–95, Z21.5–94, Z21.53–95.
2. THE CONTRACTOR SHALL PAY ALL COSTS OF PERMIT, INSPECTIONS AND ALL OTHER COSTS INCIDENTAL TO THE COMPLETION AND TESTING OF THIS WORK.
3. THE CONTRACTOR SHALL VISIT THE SITE AND COORDINATE WORK WITH OTHER TRADES.
4. THE CONTRACTOR SHALL SUPPLY THE ARCHITECT WITH "AS–BUILT" DRAWINGS.
5. CONTRACTOR SHALL SUBMIT, FOR APPROVAL FIVE [5] COPIES OF MANUFACTURER'S DRAWINGS FOR EACH PIECE OF EQUIPMENT AND CONTROLS INCLUDED IN CONTRACT.
6. ALL MATERIAL SHALL BE NEW OF U.S. MANUFACTURER OF GOOD QUALITY. ALL WORK SHALL BE PERFORMED AT INDUSTRY STANDARD QUALITY LEVEL BY CERTIFIED PROFESSIONALS. ALL EQUIPMENT SHALL BE UL OR ETL LISTED.
7. DUCTWORK:
   A. ALL DUCTWORK SHALL BE GALVANIZED SHEETMETAL WITH SEALED SEAMS AND JOINTS WITH EXTERNAL BLANKET INSULATION R–6 MIN. THE CONTRACTOR SHALL PROVIDE ALL SHEETMETAL DUCTWORK, HANGERS, AUX. SUPPORT STEEL, ETC., ALL FLEX DUCT SHALL BE RATED CLASS 1, UL–181 LISTED WITH METALLIZED INNER AND OUTER FOIL LINERS, MIN. R–6 WITH A MAX. TOTAL LENGTH NOT TO EXCEED 15 FT. INSTALL UL LISTED FOR PLENUM, FLEXIBLE DUCTWORK ELBOW SUPPORTS AT EACH DIFFUSER, GRILLE, AND REGISTER EQUAL TO "FLEXFLOW ELBOW" AS MANUFACTURED BY "THERMAFLEX". ALL METAL DUCTS SHALL BE FABRICATED IN ACCORDANCE WITH LATEST EDITION OF S.M.A.C.N.A.
   B. ALL EXPOSED SUPPLY AIR DUCT SHALL BE SPIRAL ROUND DUCTWORK WITHOUT INSULATION. THE CONTRACTOR SHALL PROVIDE ALL SHEETMETAL DUCTWORK, HANGERS, AUX. SUPPORT STEEL, ETC.
8. ALL EXHAUST DUCTS AND OUTSIDE AIR DUCTS SHALL BE GALVANIZED SHEET METAL WITH SEALED SEAMS AND JOINTS. ALL OUTSIDE AIR DUCT SHALL BE INSULATED WITH EXTERNAL BLANKET INSULATION R–6 MIN. ALL METAL EXHAUST, MAKE–UP OR OTHERWISE DUCTS INSTALLED IN LOCATIONS WHERE DEWPOINT CONDITIONS CAN OCCUR INSIDE THE DUCT SHALL BE EXTERNALLY INSULATED WITH R–6 MIN.
9. OUTSIDE AIR INTAKES SHALL BE SCREENED WITH A CORROSION RESISTANT MATERIAL NOT LARGER THAN 1/2" MESH. O/A INTAKES SHALL NOT BE TAKEN FROM A LOCATION CLOSER THAN 10 FT. FROM ANY CHIMNEY, VENT OUTLET OR SANITARY SEWER VENT OUTLET, UNLESS SUCH VENT IS NOT LESS THAN 24 INCHES ABOVE THE OUTSIDE AIR VENT. OUTSIDE AIR INTAKE VENTS LOCATED ON ROOFS WILL BE PROPERLY MARKED WITH A UNIVERSAL MARKING "INTAKE", PERMANENTLY ATTACHED PER IMC 2012, SEC. 401.5
10. DUCT SIZES SHOWN ARE INSIDE DIMENSIONS.
11. ALL AIR DEVICES (DIFFUSERS, REGISTERS AND GRILLES) SHALL BE EXPOSED SURFACE OFF WHITE BAKED ENAMEL FINISH OR AS SPECIFIED BY ARCHITECT. DEVICES SHALL BE AS SPECIFIED OR EQUAL TO TITUS PROVIDE OPPOSED BLADE DAMPERS AT ALL DIFFUSERS AND REGISTERS AS INDICATED ON PLANS. PROVIDE BALANCING DAMPERS FOR ALL AIR DEVICES TO ENSURE COMPLIANCE WITH IMC 2012, PAR. 603.17 FOR BALANCED AIR FLOW.
12. THERMOSTAT:
   A. FOR NEW UNITS: SHALL BE COMBINATION COOLING/HEATING, WITH SYSTEM "COOL–AUTO–HEAT–OFF" AND FAN "ON–AUTO" SELECTOR SWITCHES. PROVIDE PROGRAMMABLE TYPE AS RECOMMENDED BY MANUFACTURER, PROLIPHIX IMT550, HONEYWELL OR EQUAL. PROVIDE TAMPER PROOF COVERS.
   B. FOR EXISTING UNITS: SHALL BE SERVICED AND RELOCATED AS SHOWN. IF NEW THERMOSTAT IS PROVIDED IT SHALL MATCH BUILDING STANDARDS.
   C. FOR VAV BOXES: CONTROLS TO BE DDC, PROVIDE ROOM THERMOSTAT/SENSOR WITH OVERRIDE
13. REFRIGERANT LINES SHALL BE COPPER, TYPE "L" HARD DRAWN WITH WROUGHT COPPER BRAZING–JOINT TYPE FITTINGS, USE BRAZING MATERIALS FOR HIGH PRESSURE PIPING PER AWS A5.8: BCuP SERIES COPPER–PHOSPHORUS ALLOY OR BAg1 SILVER ALLOY. REFRIGERANT LINES SHALL BE SIZED PER MANUFACTURER'S RECOMMENDATIONS. SOFT COPPER TYPE "M" SHALL BE ALLOWED FOR RISER PIPING INSIDE CHASE TO LIMIT NUMBER OF JOINTS. COORDINATE WITH ENGINEER FOR PRIOR APPROVAL. ALL EXPOSED INSULATION SHALL BE PROTECTED WITH UV RESISTANT PAINT OR ALUMIN. SHIELD.
14. ARMAFLEX INSULATION SHALL BE USED FOR SUCTION LINES (1/2" FOR ABOVE 40° F AND 1" FOR BELOW 40° F) PER IECC 2009 TABLE 503.2.8 FOR PIPING INSULATION. FILTER/DRYER AND SIGHT GLASS SHALL BE PROVIDED AT LIQUID LINES.
15. ALL BRANCH TAKE–OFFS TO BE PROVIDED W/ MANUAL VOLUME DAMPERS. PROVIDE RADIUS ELBOWS WHERE FEASIBLE, SQUARE ELBOWS AND TEE'S SHALL BE FURNISHED W/SINGLE FOIL TURNING VANES. PROVIDE MANUAL VOLUME DAMPERS WITH EXTRACTOR AT ALL FLEX TAKE–OFFS. PROVIDE REMOTE, CABLE OPERATED VOLUME DAMPERS IN INACCESSIBLE AND HARD CEILING AREAS, "YOUNG REGULATOR" OR EQUAL.
16. PROVIDE NEW FILTERS FOR ALL AIR CONDITIONING EQUIPMENT BEFORE START–UP, REPLACE PRIOR TO FINAL ACCEPTANCE BY OWNER.
17. PROVIDE SMOKE DETECTORS WITH SERVICE ACCESS DOORS IN ALL SUPPLY AIR DUCTS FOR FANS AND AHU'S SERVING A COMMON PLENUM OF 2000 CFM OR ABOVE. FOR SMOKE DETECTORS NOT VISIBLE, IN CONCEALED SPACES, PROVIDE REMOTE ANNUNCIATION/TEST STATION AS REQUIRED BY AUTHORITY HAVING JURISDICTION, COORDINATE PRIOR TO INSTALLATION. DETECTORS SHALL BE BY ONE MANUFACTURER, COORDINATE VOLTAGE ETC. WITH ELECTRICAL CONTRACTOR AND FIRE ALARM SYSTEM BEFORE ORDERING. UPON DETECTION, SMOKE DETECTORS SHUT DOWN ASSOCIATED AIR MOVING EQUIPMENT AND ALL AIR MOVING EQUIPMENT SERVING THAT COMMON PLENUM.
18. PROVIDE TYPE "B" DYNAMIC FIRE DAMPERS WITH SERVICE ACCESS DOORS IN ALL DUCTS AND OPENINGS PENETRATING FIRE RATED WALLS, MECHANICAL AND ELECTRICAL EQUIPMENT ROOMS, TENANT SEPARATION, PARTITIONS, FLOOR OR ROOF SLABS AND AT OUTSIDE AIR INTAKES AS REQUIRED. PROVIDE RADIATION DAMPERS IN RATED CEILINGS FOR ALL CEILING OPENINGS, CEILING FANS, DIFFUSERS OR GRILLES RATED FOR USE IN THE CEILING ASSEMBLY. PROVIDE LOW–LEAKAGE CLASS DAMPERS FOR ALL SITUATIONS WHERE THE AIRFLOW CFM HAS TO BE CONTROLLED. VERIFY AND REPLACE AS REQUIRED FOR EXISTING SYSTEMS.
19. HVAC CONTRACTOR SHALL PROVIDE A T & B REPORT PER IECC 2009 (THE T & B REPORT SHALL BE INDEPENDENT FOR SYSTEMS OVER 15 TONS) FOR ALL MECHANICAL EQUIPMENT, AIR DEVICES, DAMPERS, AHU'S AND FANS. THE TEST AND BALANCE REPORT SHALL BE IN ACCORDANCE WITH THE AIR BALANCE COUNCIL STANDARDS AND SHALL INCLUDE AIR QUANTITIES FOR ALL SUPPLY GRILLES, RETURN GRILLES AND EXHAUST GRILLES AND THE LEAVING AND ENTERING AIR TEMPERATURE (°F) FROM SUPPLY GRILLES AND EVAPORATORS.
20. THERMOSTAT LOCATION SHALL BE APPROVED BY OWNER AND ENGINEER BEFORE INSTALLATION. INSTALL THERMOSTAT 48" TO 54" A.F.F. PER A.D.A REQUIREMENTS WHERE APPLICABLE. MECHANICAL CONTRACTOR SHALL COORDINATE WITH ELECTRICAL CONTRACTOR ALL REQUIREMENTS FOR JUNCTION BOXES, CONDUITS, CONTROL WIRING, POWER, ETC. AND DEFINE RESPONSIBILITIES AND SCOPE OF WORK FOR EACH TRADE PRIOR TO ANY PURCHASING OR INSTALLATION.
21. RUN INSULATED FIRE RATED CONDENSATE DRAINS AS REQUIRED.
22. ALL INSULATION WILL HAVE FIRE/SMOKE RATING LESS THAN 25/50.
23. MECHANICAL EQUIPMENT ON ROOF OR ELEVATED STRUCTURES SHALL COMPLY WITH IMC 2012 PAR. 306.5 IF INSTALLED HIGHER THAN 16 FEET A.F.F. MECHANICAL EQUIPMENT INSTALLED IN ATTICS SHALL MEET THE REQUIREMENTS OF IMC 2012 PAR. 306.3 IF THE EQUIPMENT CAN NOT BE SERVICED/REMOVED THROUGH REQUIRED OPENING. MECHANICAL EQUIPMENT SHALL BE PROTECTED WITH MECHANICAL BARRIERS IF EXPOSED TO MECHANICAL DAMAGE. ALL EQUIPMENT SHALL BE INSTALLED ON 6" CONCRETE PAD AT GRADE LEVEL.
   SPECIAL NOTES:
   ALL WIND LOAD AND OTHER COMPLIANCE CALCULATIONS FOR ROOF MOUNTED EQUIPMENT, AS REQUIRED BY IBC 2012, SEC. 1509 AND CHAPTER 16, SHALL BE PROVIDED BY STRUCTURAL ENGINEER/ARCHITECT.
24. PROVIDE A MIN. OF 36" CLEARANCE IN FRONT OF ALL 120–208 VOLT PANELS AND MIN. 42" CLEARANCE IN FRONT OF ANY 240–480 VOLT PANEL. PROVIDE ADEQUATE SIDE CLEARANCE PER NEC.
25. MECHANICAL PLANS IN GENERAL, ARE DIAGRAMMATIC IN NATURE, AND ARE TO BE READ IN CONJUNCTION WITH ARCHITECTURAL, PLUMBING, ELECTRICAL, AND STRUCTURAL PLANS AND SHALL BE CONSIDERED AS ONE SET OF DOCUMENTS. DUCT AND PIPING OFFSETS, BENDS AND TRANSITIONS SHALL BE REQUIRED TO PROVIDE AND INSTALL A COMPLETE FUNCTIONAL SYSTEM AND SHALL BE PROVIDED BY THE CONTRACTOR AT NO ADDITIONAL COST TO THE OWNER. CHANGES IN DUCTWORK SIZE AND ROUTE WILL BE REQUIRED TO AVOID STRUCTURAL, PLUMBING, AND ARCHITECTURAL BUILDING FEATURES. DUCTWORK CHANGES MAY BE MADE BY CONTRACTOR USING EQUIVALENT SIZED DUCT. CONTACT ENGINEER IF DUCT AREA WILL NOT FIT.
26. THE CONTRACTOR SHALL VERIFY EXISTING CONDITIONS PRIOR TO BIDDING, ORDERING, FABRICATION OR INSTALLATION OF MATERIALS OR EQUIPMENT.
27. NO COMBUSTIBLE MATERIALS ARE ALLOWED IN RETURN AIR PLENUMS OR ABOVE CEILINGS USED AS RETURN AIR PLENUM. IF SPACE WITH RETURN AIR PLENUM HAS ANY DECK TO DECK PARTITIONS, AIR TRANSFER DUCTS MUST BE INSTALLED. WHEN CPVC PIPING IS USED FOR WATER SYSTEMS, THE R/A GRILLES LAYOUT SHALL BE (FIELD) COORDINATED WITH SUCH PIPING SO THAT NO PORTION OF THE GRILLES WILL BE DIRECTLY BELOW THE CPVC PIPING.
28. MANUFACTURER'S WARRANTY: CONTRACTOR SHALL PROVIDE WARRANTY FOR A PERIOD OF (1) ONE YEAR AFTER BUILDING C.O. FOR ALL MECHANICAL SYSTEMS, DUCTWORK, CONTROLS ACCESSORIES AND ALL OTHER EQUIPMENT, PARTS AND LABOR UNDER THESE DRA–NGS AND AND SPECIFICATIONS. CONTRACTOR SHALL PROVIDE WARRANTY FOR COMPRESSORS FOR (5) FIVE YEARS. ANY REPAIRS REQUIRING SYSTEM SHUTDOWN ALL BE DONE DURING NON–OPERATIONAL PERIODS OR AS AGREED WITH OWNER.
29. THIS IS A REMODEL OF AN EXISTING SPACE. CONTRACTOR TO VISIT SITE PRIOR TO BID. CONTRACTOR SHALL INSPECT ALL EXISTING AND NEW COMPONENTS OF THE MECHANICAL SYSTEMS AND ENSURE THAT ALL ARE OPERATIONAL AND WORKING AS SHOWN ON THE APPROVED CD PLANS AT THE TIME OF C.O.

MECHANICAL SHEET INDEX

SHEET#	DESCRIPTION
M0.1	MECHANICAL NOTES, LEGEND AND INDEX
M1.0	MECHANICAL DEMO PLAN – GROUND FLOOR
M1.1	MECHANICAL DEMO PLAN – FIRST FLOOR
M1.2	MECHANICAL DEMO PLAN – SECOND FLOOR
M1.3	MECHANICAL DEMO PLAN – THIRD FLOOR
M1.4	MECHANICAL DEMO PLAN – FOURTH FLOOR
M2.0	MECHANICAL PROPOSED PLAN – GROUND FLOOR
M2.1	MECHANICAL PROPOSED PLAN – FIRST FLOOR
M2.2	MECHANICAL PROPOSED PLAN – SECOND FLOOR
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M4.1	MECHANICAL 3D VIEWS
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M7.1	MECHANICAL DETAILS
M8.1	MECHANICAL CONTROL DIAGRAMS
M8.2	MECHANICAL CONTROL DIAGRAMS

MECHANICAL LEGEND

R	REFRIGERANT PIPING
	DROPPING OR RISING PIPE
	PIPE TO OR FROM ABOVE
	ISOLATING GATE OR BALL VALVE
24"x12"	RECTANGULAR DUCT SIZE: FIRST DIMENSION IS SIDE DRAWN
24"/12"	FLAT OVAL DUCT SIZE: FIRST DIMENSION IS SIDE DRAWN
12"ø	ROUND DUCTWORK OR FLUE PIPING
	RECTANGULAR TO ROUND DUCT TRANSITION
	FLEXIBLE ROUND DUCT
	ADJUSTABLE DEFLECTOR VANES AT BRANCH DUCT
	SQUARE DUCT ELBOW WITH TURNING VANES
	MANUAL VOLUME DAMPER
FD	FIRE DAMPER IN DUCT THROUGH WALL
MD	AUTOMATIC (MOTORIZED) CONTROL DAMPER
	ONE INCH THICK DUCT LINER
	BELLMOUTH TAP
	SPIN–IN TAP
	SHOE TAP DAMPER
(D)	DUCT SMOKE DETECTOR
(T)	EXISTING WALL MOUNTED THERMOSTAT WITH TEMPERATURE SENSOR
T	WALL MOUNTED THERMOSTAT WITH TEMPERATURE SENSOR
T RS	WALL MOUNTED THERMOSTAT WITH REMOTE TEMPERATURE SENSOR
R	REMOTE TEMPERATURE SENSOR
CO	CARBON MONOXIDE SENSOR
S	WALL MOUNTED FAN SWITCH
	WALL MOUNTED TIME CLOCK
	DOOR GRILLE
U.C.	UNDERCUT DOOR 3/4"
	CONCRETE PAD

MECHANICAL ABBREVIATION LEGEND

AFF	ABOVE FINISHED FLOOR	LAT	LEAVING AIR TEMPERATURE
APPROX	APPROXIMATE	Ldb	LEAVING DRY BULB
BAS	BUILDING AUTOMATION SYSTEM	Lwb	LEAVING WET BULB
CFM	CUBIC FEET PER MINUTE	MAX	MAXIMUM
DIA	DIAMETER	MBH	THOUSAND BTU PER HOUR
db	DRY BULB	MIN	MINIMUM
DX	DIRECT EXPANSION	N	NEW
E/A	EXHAUST AIR	O/A	OUTDOOR AIR
EER	ENERGY EFFICIENCY RATING	PD	PRESSURE DROP
EAT	ENTERING AIR TEMPERATURE	PSIG	POUNDS PER SQUARE INCH GAUGE
Edb	ENTERING DRY BULB	RE	RELOCATE EXISTING
ESP	EXTERNAL STATIC PRESSURE	RPM	REVOLUTIONS PER MINUTE
ETR	EXISTING TO REMAIN	SEER	SEASONAL ENERGY EFFICIENCY RATING
Ewb	ENTERING WET BULB	SQ. FT.	SQUARE FEET
FT	FEET	TEMP	TEMPERATURE
FLA	FULL LOAD AMPERAGE	TYP	TYPICAL
H	HEIGHT	V	VOLTS
HP	HORSE POWER	W	WIDTH
IN	INCHES	wb	WET BULB
IN. WG	INCHES WATER GAUGE	°F	DEGREES FAHRENHEIT
kW	KILOWATTS	Δt	TEMPERATURE DIFFERENCE

GENERAL DEMOLITION NOTES

1. THE CONTRACTOR SHALL PROVIDE PROTECTION FOR ALL PARTS OF THE BUILDING, ITS CONTENTS AND OCCUPANTS WHEREVER WORK UNDER THIS CONTRACT IS PERFORMED.
2. DEMOLITION SHALL INCLUDE REMOVAL OF EXISTING BUILDING CONSTRUCTION TO EXTENT REQUIRED TO PERFORM CONSTRUCTION ACTIVITIES INDICATED.
3. THE DEMOLITION PROCEDURES SHALL PROVIDE FOR SAFE CONDUCT OF THE WORK, PROTECTION OF PERSONNEL, CAREFUL REMOVAL AND DISPOSITION OF MATERIALS SPECIFIED TO BE SALVAGED, PROTECTION OF PROPERTY TO REMAIN UNDISTURBED, COORDINATION WITH OTHER WORK IN PROGRESS, AND TIMELY DISCONNECTION OF UTILITY SERVICES.
4. EXISTING WORK TO REMAIN SHALL BE PROTECTED FROM DAMAGE. WORK DAMAGED BY THE CONTRACTOR SHALL BE REPAIRED TO MATCH EXISTING WORK OR WORK INSTALLED UNDER THIS CONTRACT DEPENDING ON CONTRACT REQUIREMENTS.
5. EXISTING WORK SHALL BE CUT, DRILLED, ALTERED, REMOVED OR TEMPORARILY REMOVED AND REPLACED FOR PERFORMANCE OF WORK UNDER THE CONTRACT. WORK DEFACED DURING THIS CONTRACT SHALL BE RESTORED TO THE CONDITION AT TIME OF AWARD OF CONTRACT. CUT ALTER, REMOVE OR TEMPORARILY REMOVE AND REPLACE EXISTING WORK FOR THE INSTALLATION OF MECHANICAL, PLUMBING AND ELECTRICAL WORK AND OTHER CONSTRUCTION.
6. PROPERLY REMOVE AND DISPOSE OF ALL EXISTING FIXTURES AS REQUIRED TO ACCOMODATE NEW PLAN. REFER TO THE ARCHITECTURAL DEMOLITION PLANS. CONSULT WITH THE OWNER AND OBTAIN OWNERS APPROVAL PRIOR TO DISPOSAL OF REMOVED MATERIAL.
7. FOR ALL ADDITIONAL INFORMATION REGARDING CONTRACTURAL RESPONSIBILITIES, COORDINATE WITH ARCHITECTURAL PLANS.

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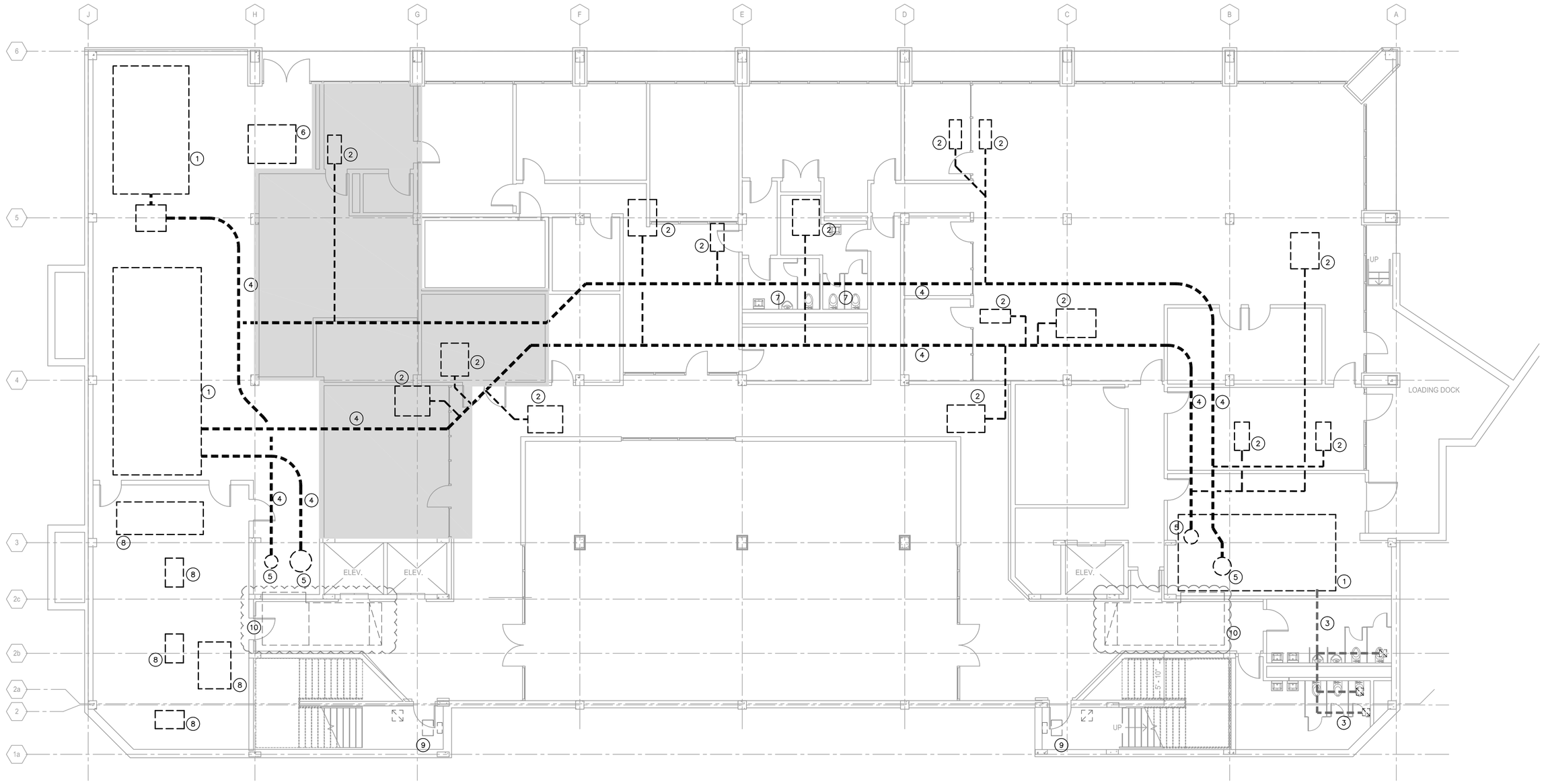
SHEET ISSUE:

NO.	DATE	DESCRIPTION	BY
	12/04/14	ISSUED FOR BID	
	01/21/15	ADDENDUM 3	

PRINCIPAL IN CHARGE: DPF
PROJECT ARCHITECT: -
DRAWN BY: GD

SHEET TITLE:
MECHANICAL NOTES, LEGEND AND INDEX

SHEET NO. M0.1
PROJ. NO. 013328.00



KEY NOTES

1. REMOVE EXISTING CHILLED WATER AIR HANDLING UNIT.
2. REMOVE EXISTING VAV UNIT ABOVE CEILING AND ALL ASSOCIATED DUCTWORK DIFFUSERS AND T-STATS..
3. EXISTING RESTROOM E/A SYSTEM TO REMAIN. SEE SHEET M2.0 FOR ADDITIONAL WORK.
4. REMOVE EXISTING MEDIUM PRESSURE DUCT.
5. REMOVE EXISTING MEDIUM PRESSURE RISER.
6. EXISTING LIEBERT UNIT AND ALL ASSOCIATED DUCTWORK TO REMAIN.
7. REMOVE EXISTING RESTROOM E/A SYSTEM, INCLUDING REGISTERS, DUCTWORK, FAN AND ACCESSORIES.
8. EXISTING MECHANICAL EQUIPMENT IN MECHANICAL ROOM TO REMAIN.
9. EXISTING HOT WATER UNIT HEATER ABOVE CEILING AND ALL ASSOCIATED DUCTWORK, DIFFUSERS, PIPING AND ACCESSORIES TO REMAIN.
10. REUSE EXISTING RETURN AIR DUCT AS RELIEF AIR DUCT. PROVIDE NEW FIRE SMOKE DAMPER.

NOTE:
ALL EXISTING DUCTWORK, CONDUIT, CABLE, PIPING, HANGERS AND SUPPORT THAT ARE NOT BEING REUSED TO BE REMOVED IN THEIR ENTIRETY.

1 / M1.0 MECHANICAL DEMO PLAN - GROUND FLOOR
1/8" = 1'-0"

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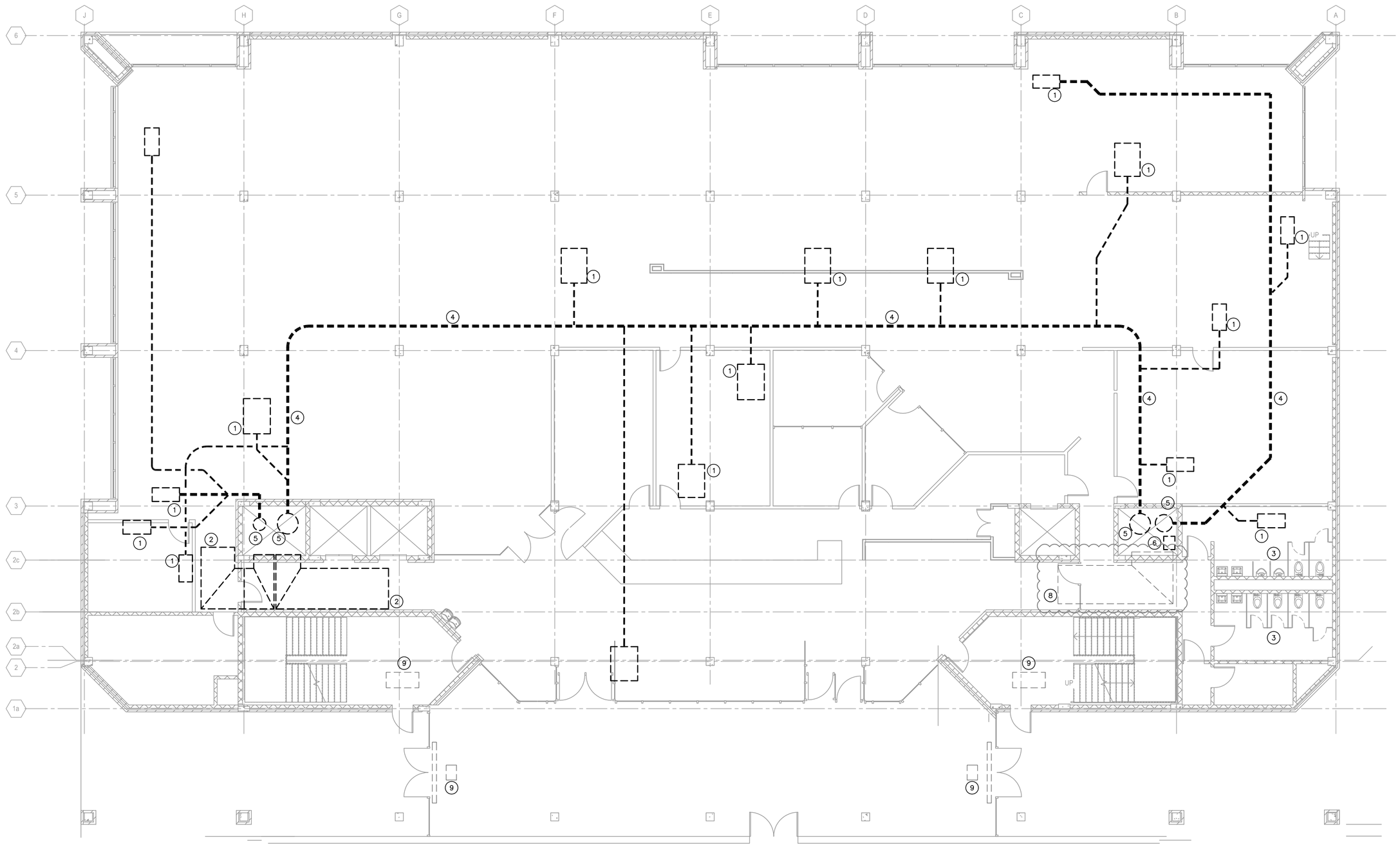
SHEET ISSUE:

NO.	DATE	DESCRIPTION	BY
	12/04/14	ISSUED FOR BID	
	01/21/15	ADDENDUM 3	

PRINCIPAL IN CHARGE: DPF
PROJECT ARCHITECT: -
DRAWN BY: GD

SHEET TITLE:
MECHANICAL DEMO PLAN - GROUND FLOOR

SHEET NO. M1.0
PROJ. NO. 013328.00



1 M1.1 MECHANICAL DEMO PLAN - FIRST FLOOR

1/8" = 1'-0"

KEY NOTES

1. REMOVE EXISTING VAV UNIT ABOVE CEILING AND ALL ASSOCIATED DUCTWORK DIFFUSERS AND T-STATS..
2. REMOVE EXISTING RETURN AIR DUCT.
3. EXISTING RESTROOM E/A SYSTEM TO REMAIN. SEE SHEET M2.1 FOR ADDITIONAL WORK.
4. REMOVE EXISTING MEDIUM PRESSURE DUCT.
5. REMOVE EXISTING MEDIUM PRESSURE RISER.
6. EXISTING EXHAUST AIR RISER TO REMAIN.
7. EXISTING HOT WATER UNIT HEATER ABOVE CEILING AND ALL ASSOCIATED DUCTWORK, DIFFUSERS, PIPING AND ACCESSORIES TO REMAIN.
8. REUSE EXISTING RETURN AIR DUCT AS RELIEF AIR DUCT. PROVIDE NEW FIRE SMOKE DAMPER.

NOTE:
ALL EXISTING DUCTWORK, CONDUIT, CABLE, PIPING, HANGERS AND SUPPORT THAT ARE NOT BEING REUSED TO BE REMOVED IN THEIR ENTIRETY.

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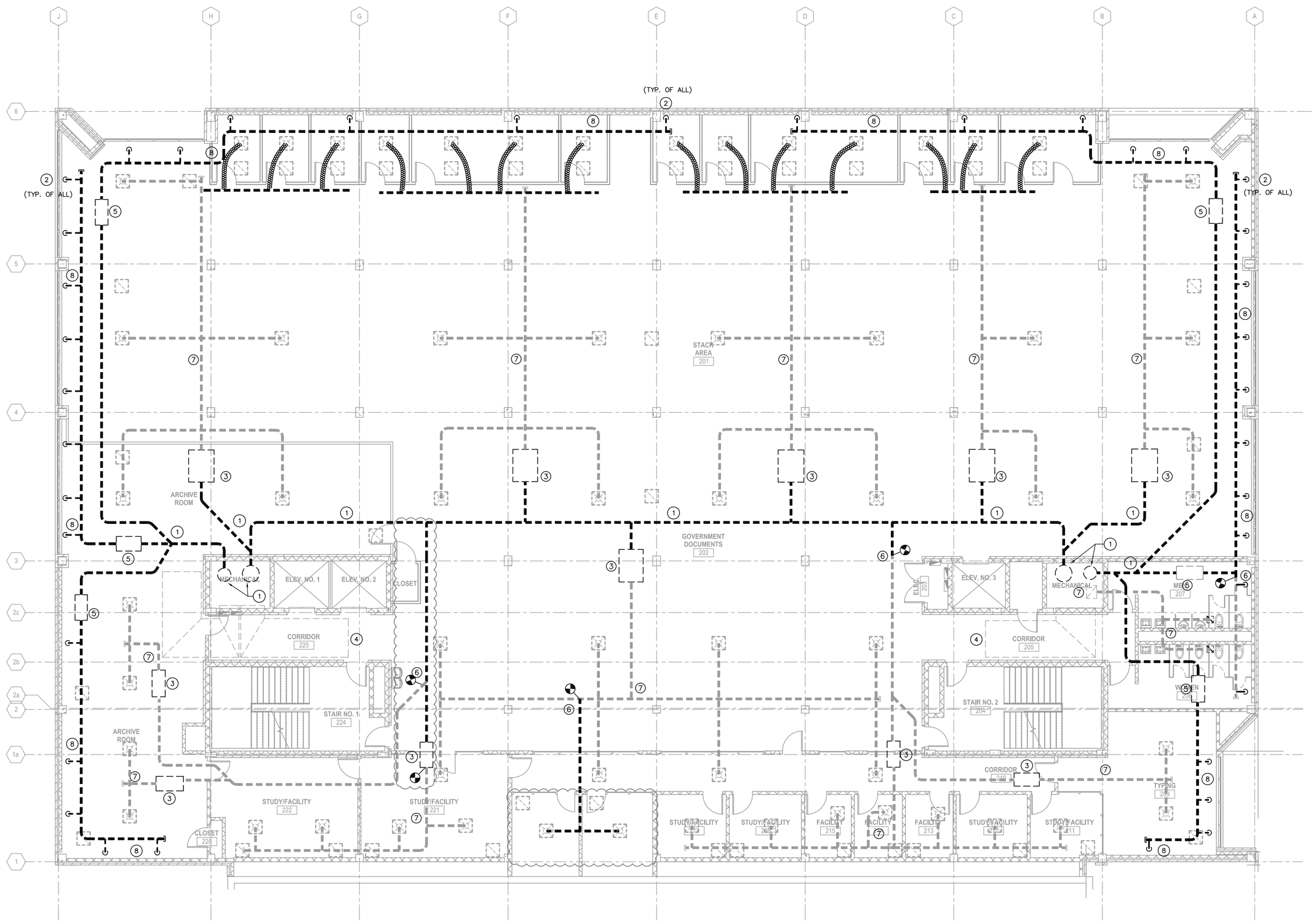
PRINCIPAL IN CHARGE: DPF
PROJECT ARCHITECT: -
DRAWN BY: GD

SHEET TITLE:
MECHANICAL DEMO PLAN - FIRST FLOOR

SHEET NO. M1.1

PROJ. NO. 013328.00



1 / M1.2 MECHANICAL DEMO PLAN - SECOND FLOOR

1/8" = 1'-0"

KEY NOTES

1. REMOVE EXISTING HIGH PRESSURE DUCT WORK ABOVE CEILING. FIELD VERIFY EXACT LOCATION.
2. REMOVE EXISTING SUPPLY AIR NOZZLES.
3. REPLACE EXISTING VAV BOX WITH PNEUMATIC CONTROLS WITH NEW BOX AND CONTROLS. SEE SHEET M2.2 FOR SCOPE OF WORK.
4. EXISTING RETURN AIR DUCT ABOVE CEILING TO REMAIN.
5. REMOVE EXISTING VAV BOX AND ALL ASSOCIATED DUCTWORK AND ACCESSORIES.
6. REMOVE EXISTING SUPPLY AIR DUCT UP TO POINT OF CONNECTION SYMBOL.
7. EXISTING LOW PRESSURE DUCTWORK AND AIR DISTRIBUTION FOR THIS ZONE TO REMAIN.
8. REMOVE EXISTING LOW PRESSURE DUCTWORK.

MECHANICAL LEGEND

	EXISTING DUCTWORK AND ACCESSORIES TO REMAIN.
	REMOVE EXISTING DUCTWORK AND ACCESSORIES.

NOTE:
ALL EXISTING DUCTWORK, CONDUIT, CABLE, PIPING, HANGERS AND SUPPORT THAT ARE NOT BEING REUSED TO BE REMOVED IN THEIR ENTIRETY.

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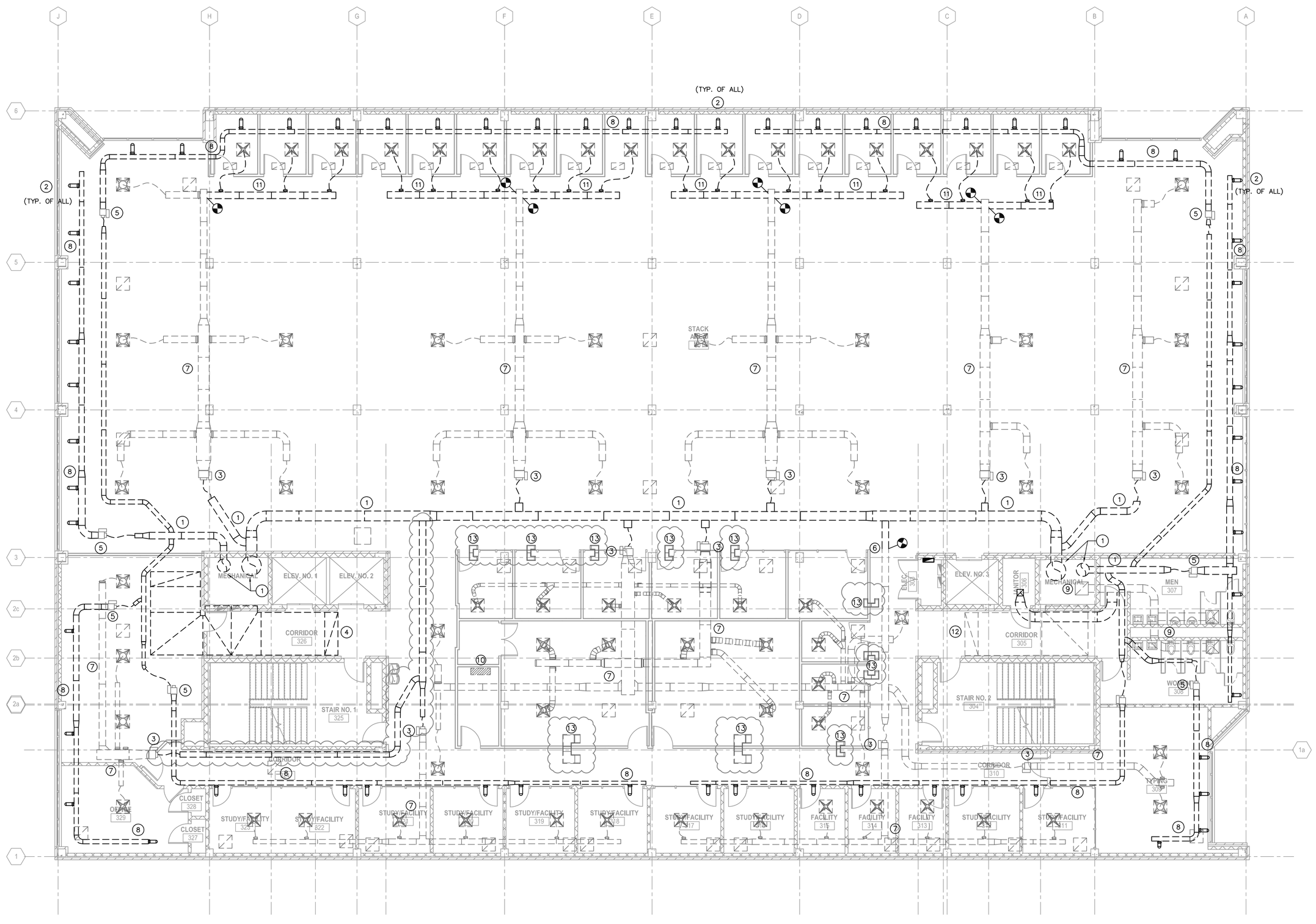
PRINCIPAL IN CHARGE: DPF
PROJECT ARCHITECT:
DRAWN BY: GD

SHEET TITLE:
MECHANICAL DEMO PLAN - SECOND FLOOR

SHEET NO. M1.2
PROJ. NO. 013328.00



1 M1.3 MECHANICAL DEMO PLAN - THIRD FLOOR

1/8" = 1'-0"

KEY NOTES

1. REMOVE EXISTING HIGH PRESSURE DUCT WORK ABOVE CEILING. FIELD VERIFY EXACT LOCATION.
2. REMOVE EXISTING SUPPLY AIR NOZZLES.
3. EXISTING VAV BOX. SEE SHEET M2.3 FOR ADDITIONAL SCOPE OF WORK.
4. REMOVE EXISTING RETURN AIR DUCT ABOVE CEILING AND ALL ASSOCIATED DUCTWORK AND ACCESSORIES.
5. REMOVE EXISTING VAV BOX AND ALL ASSOCIATED DUCTWORK AND ACCESSORIES.
6. REMOVE EXISTING SUPPLY AIR DUCT UP TO POINT OF CONNECTION SYMBOL.
7. EXISTING LOW PRESSURE DUCTWORK AND AIR DISTRIBUTION FOR THIS ZONE TO REMAIN.
8. REMOVE EXISTING LOW PRESSURE SUPPLY DUCTWORK.
9. EXISTING EXHAUST AIR DISTRIBUTION DUCTWORK ABOVE CEILING TO REMAIN.
10. EXISTING DUCTLESS SPLIT SYSTEM TO REMAIN.
11. REMOVE EXISTING FLEX DUCTWORK AND ASSOCIATED BRANCH DUCTWORK ABOVE CEILING UP TO POINT OF CONNECTION AND CAP EXISTING DUCT.
12. EXISTING RETURN AIR DUCT ABOVE CEILING TO REMAIN.
13. EXISTING TRANSFER DUCT TO REMAIN.

MECHANICAL LEGEND

	EXISTING DUCTWORK AND ACCESSORIES TO REMAIN.
	REMOVE EXISTING DUCTWORK AND ACCESSORIES.

NOTE:
ALL EXISTING DUCTWORK, CONDUIT, CABLE, PIPING, HANGERS AND SUPPORT THAT ARE NOT BEING REUSED TO BE REMOVED IN THEIR ENTIRETY.

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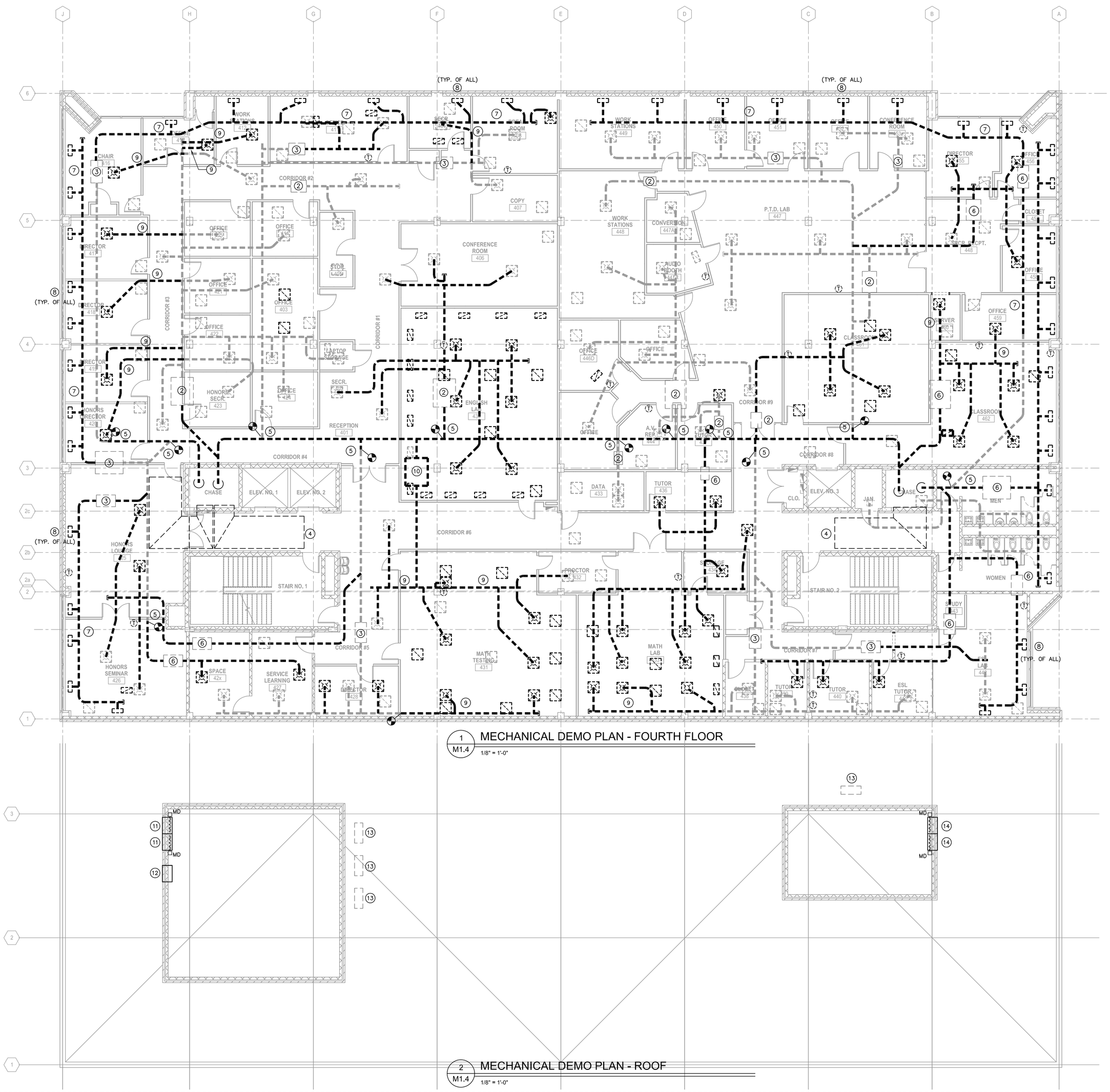
PRINCIPAL IN CHARGE: DPF
PROJECT ARCHITECT:
DRAWN BY: GD

SHEET TITLE:
MECHANICAL DEMO PLAN - THIRD FLOOR

SHEET NO.
M1.3

PROJ. NO.
013328.00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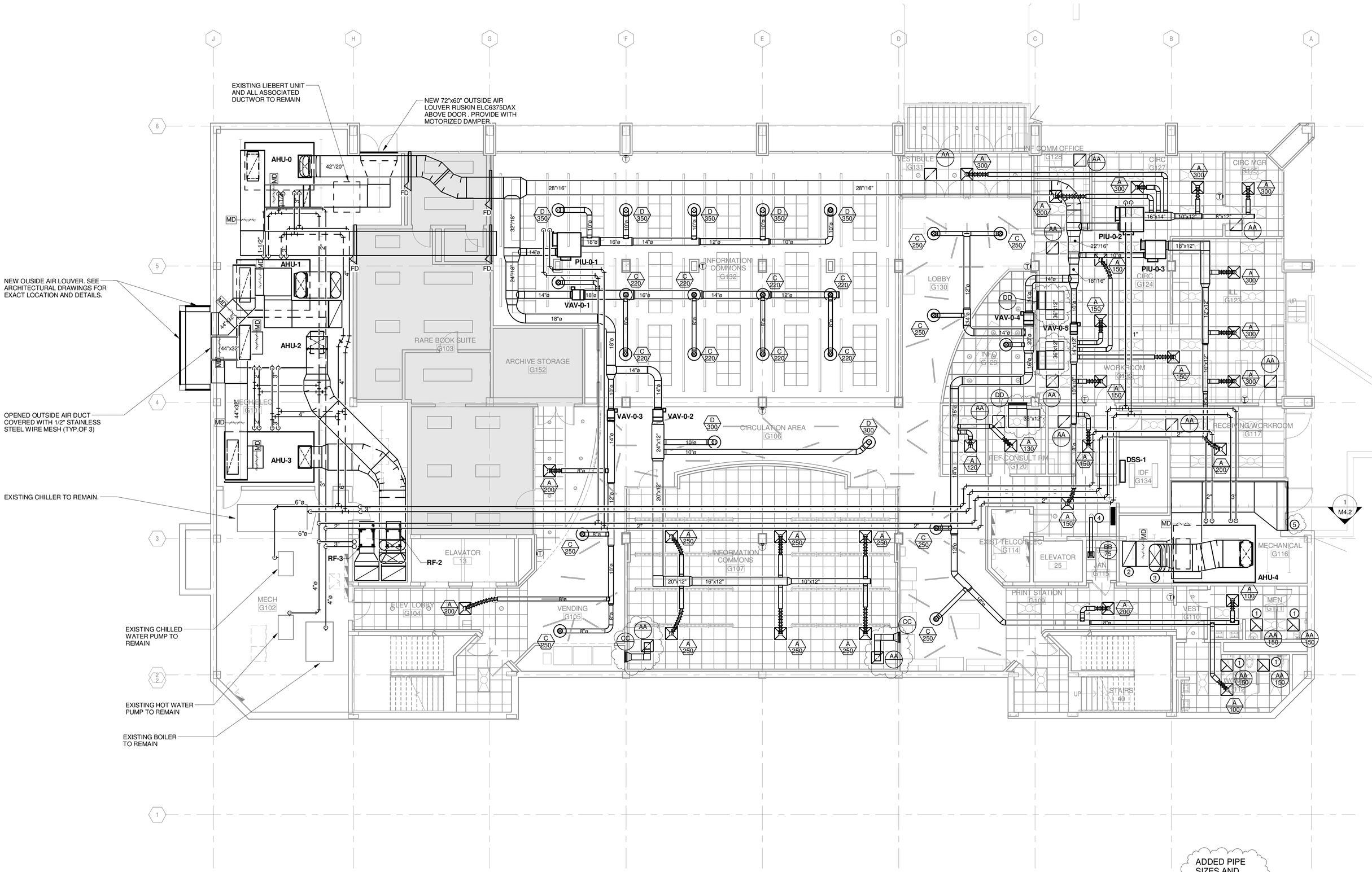
WORK
CHAIR
CORRIDOR #2
COPY
407
CONFERENCE ROOM
406
WORK STATIONS
449
CONFERENCE ROOM
DIRECTOR
OFFICE
CLOSET
P.T.D. LAB
447
WORK STATIONS
CONVERSION
447A
AUDIO BOOTH
447B
DIRECTOR
448
OFFICE
OFFICE
OFFICE



KEY NOTES

1. PROVIDE NEW EXHAUST AIR REGISTER AND RECONNECT TO EXISTING EXHAUST AIR DUCT ABOVE CEILING.
2. RETURN AIR DUCT UP TO 4TH FLOOR.
3. SUPPLY AIR DUCT UP TO 4TH FLOOR.
4. CONNECT NEW EXHAUST AIR DUCT TO EXISTING EXHAUST AIR DUCT ABOVE CEILING.
5. REPLACE EXISTING LOUVER AND PROVIDE NEW OUTSIDE AIR LOUVER ABOVE DOOR.

1 M2.0 MECHANICAL PROPOSED PLAN - GROUND FLOOR

1/8" = 1'-0"

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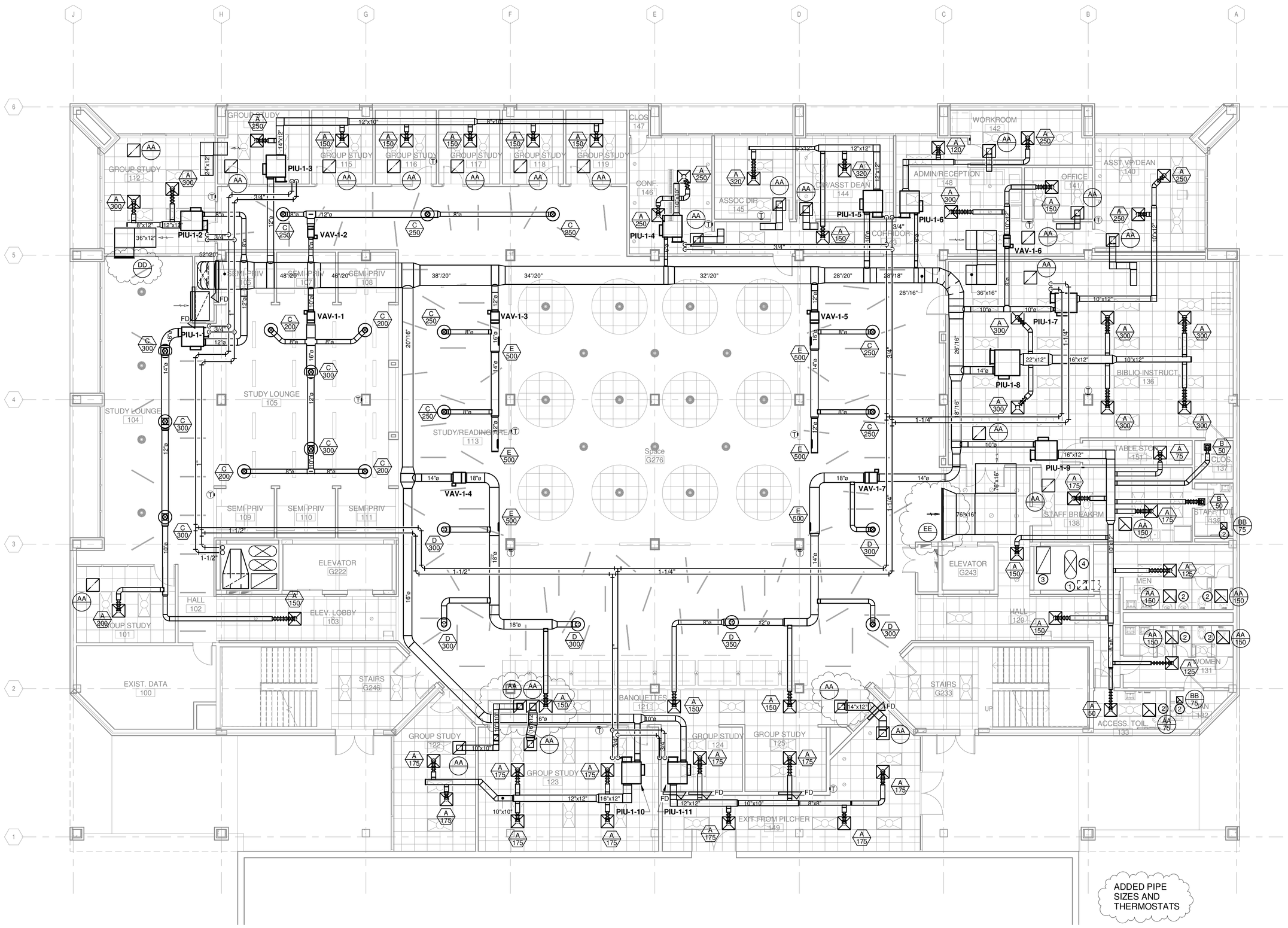
	01/21/15	ADDENDUM 3	

PRINCIPAL IN CHARGE:	DPF
PROJECT ARCHITECT:	DPF
DRAWN BY:	GD

SHEET TITLE:
MECHANICAL PROPOSED PLAN - GROUND FLOOR

SHEET NO. M2.0

PROJ. NO. 013328.00



1 M2.1 MECHANICAL PROPOSED PLAN - FIRST FLOOR

1/8" = 1'-0"

KEY NOTES

1. EXISTING EXHAUST AIR RISER TO REMAIN.
2. PROVIDE NEW EXHAUST AIR REGISTER AND RECONNECT TO EXISTING EXHAUST AIR DUCT ABOVE CEILING.
3. RETURN AIR DUCT FROM BELOW AND UP TO 4TH FLOOR.
4. SUPPLY AIR DUCT FROM BELOW AND UP TO 4TH FLOOR.

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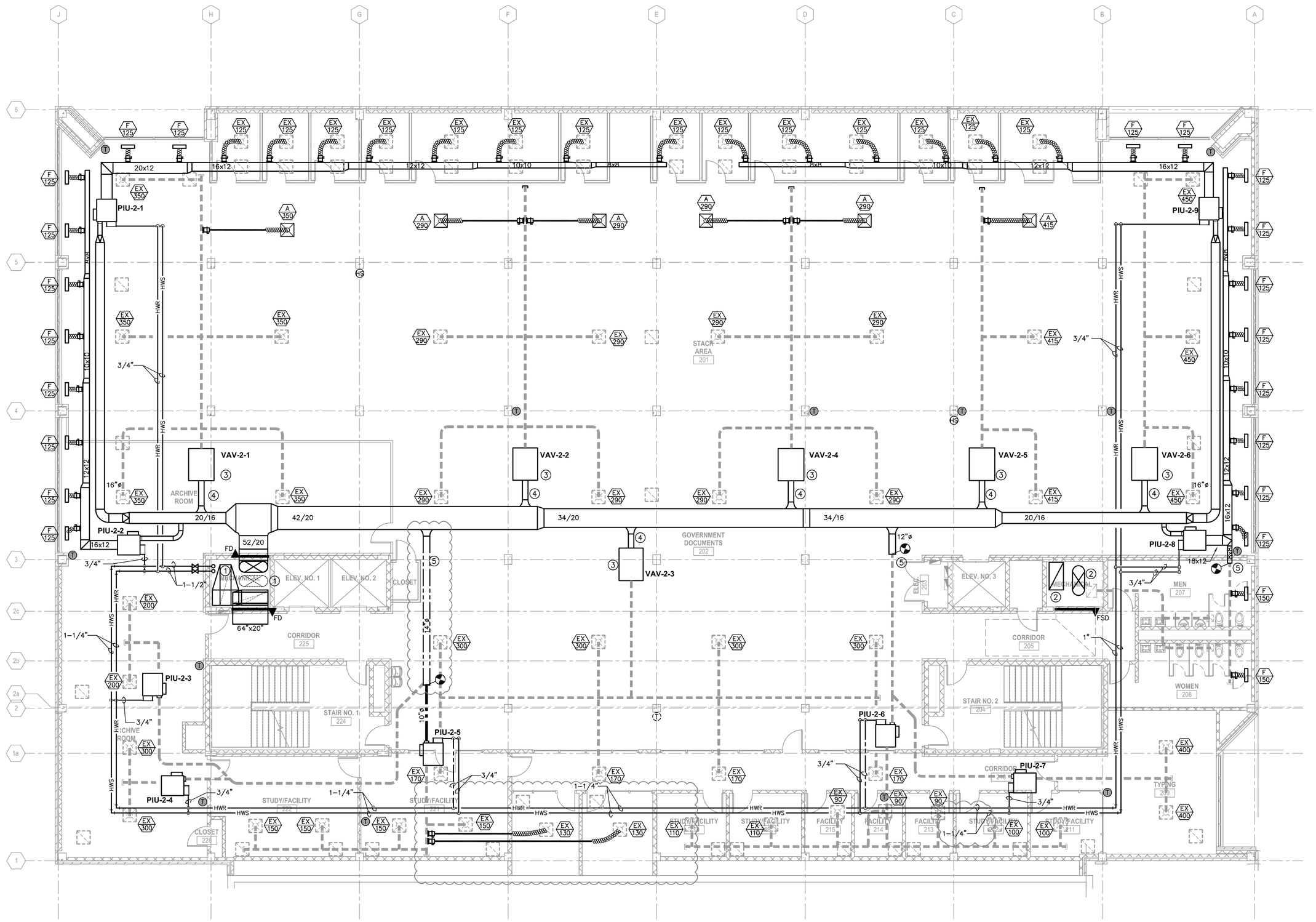
	01/21/15	ADDENDUM 3	

PRINCIPAL IN CHARGE: DPF
PROJECT ARCHITECT: DPF
DRAWN BY: GD

SHEET TITLE:
MECHANICAL PROPOSED PLAN - FIRST FLOOR

SHEET NO. M2.1

PROJ. NO. 013328.00



1 M2.2 MECHANICAL PROPOSED PLAN - SECOND FLOOR

1/8" = 1'-0"

KEY NOTES

1. SUPPLY AND RETURN AIR DUCT UP IN CHASE TO SERVE 3RD FLOOR.
2. SUPPLY AND RETURN AIR DUCT UP IN CHASE TO SERVE 4TH FLOOR.
3. PROVIDE NEW VAV BOX, SEE SCHEDULE ON SHEET M6.1.
4. PROVIDE NEW TAP FOR NEW VAV BOX.
5. CONNECT EXISTING TO NEW AT THIS LOCATION. VERIFY EXISTING SIZE & PROVIDE TRANSITIONS AS REQUIRED.

ADDED CFMs FOR ALL EXISTING DIFFUSERS.

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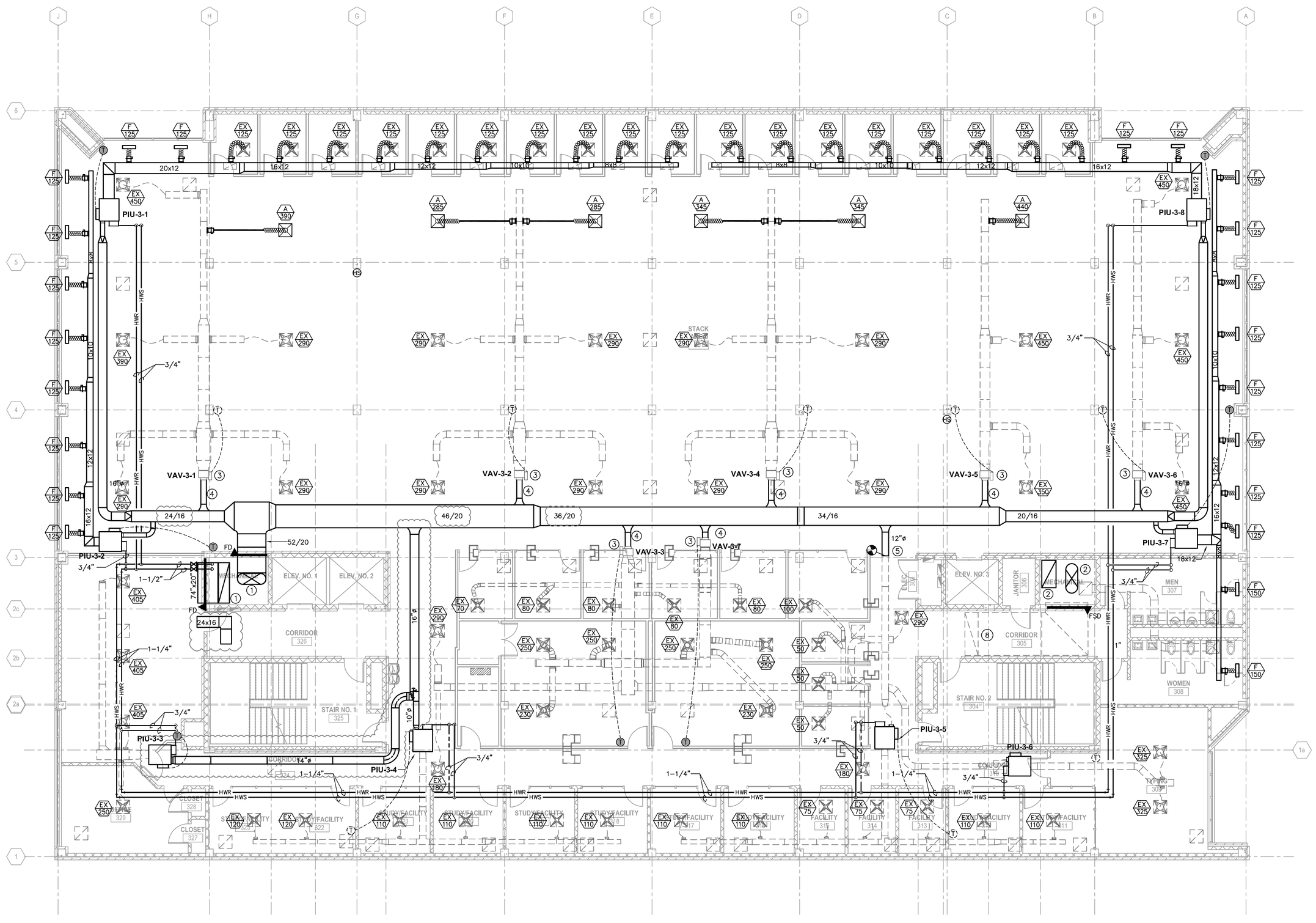
	01/21/15	ADDENDUM 3	

PRINCIPAL IN CHARGE: DPF
PROJECT ARCHITECT:
DRAWN BY: GD

SHEET TITLE:
MECHANICAL PROPOSED PLAN - SECOND FLOOR

SHEET NO. M2.2

PROJ. NO. 013328.00



1 M2.3 MECHANICAL PROPOSED PLAN - THIRD FLOOR

1/8" = 1'-0"

KEY NOTES

1. SUPPLY AND RETURN AIR DUCT UP IN CHASE TO SERVE 3RD FLOOR.
2. SUPPLY AND RETURN AIR DUCT UP IN CHASE TO SERVE 4TH FLOOR.
3. VAV BOXES TO BE UPGRADED WITH DDC CONTROL TO MATCH NEW WHOLE BUILDING DDC SYSTEM.
4. PROVIDE NEW TAP FOR EXISTING VAV BOX.
5. CONNECT EXISTING TO NEW AT THIS LOCATION. VERIFY EXISTING SIZE & PROVIDE TRANSITIONS AS REQUIRED.
8. RELIEF AIR OPENING ABOVE CEILING WITH FIRE SMOKE DAMPER. RELIEF AIR UP TO LOUVERS ON ROOF PENTHOUSE. SEE SHEET M1.4 FOR EXACT LOCATION.

ADDED DUCT SIZES AND DIFFUSERS CFMs

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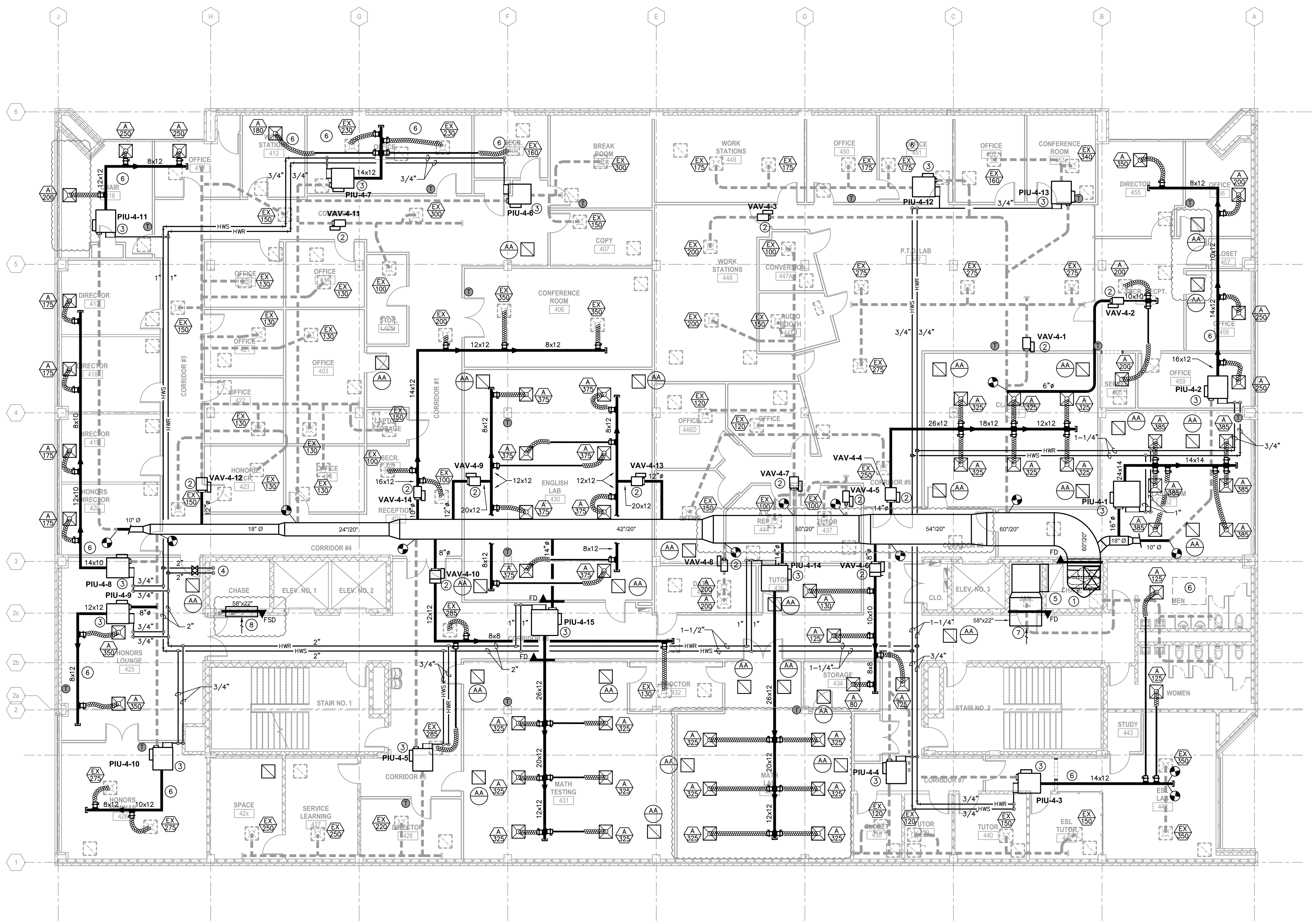
SHEET TITLE:
MECHANICAL PROPOSED PLAN - THIRD FLOOR

SHEET NO.
M2.3

PROJ. NO.
013328.00



1 / M2.4 — MECHANICAL PROPOSED PLAN - FOURTH FLOOR

1/8" = 1'-0"

ADDED DUCT SIZES AND DIFFUSERS CFMs

KEY NOTES

1. DUCT UP IN CHASE TO SERVE 4TH FLOOR – SUPPLY AND RETURN AIR.
2. NEW VAV BOXES. SEE SCHEDULE ON SHEET M6.1.
3. PROVIDE NEW FAN POWERED BOX AT LOCATION OF EXISTING VAV BOX. RECONNECT DUCTWORK AS REQUIRED.
4. NEW HOT WATER SUPPLY AND RETURN RISERS.
5. PROVIDE NEW OUTSIDE AIR DUCT AND EXTEND TO LOUVER ON SIDE OF SHAFT ABOVE ROOF.
6. PROVIDE NEW SUPPLY AIR DUCT FOR THIS ZONE.
7. OPENED RETURN AIR DUCT ABOVE CEILING COVERED WITH 1/2" STAINLESS STEEL WIRE MESH.
8. RELIEF AIR OPENING ABOVE CEILING WITH FIRE SMOKE DAMPER. RELIEF AIR UP TO LOUVERS ON ROOF PENTHOUSE. SEE SHEET M1.4 FOR EXACT LOCATION.

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PRINCIPAL IN CHARGE: DPF
PROJECT ARCHITECT: -
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SHEET TITLE:
MECHANICAL PROPOSED PLAN - FOURTH FLOOR

SHEET NO. M2.4

PROJ. NO. 013328.00

RETURN FAN SCHEDULE

MARK	GREENHECK MODEL	SERVICE AREA	CONFIGUR.	TOTAL EXHAUST CFM	APPROX. ESP IN WG	SONES	SUPPLY FAN HP	RPM	DRIVE	VOLTAGE PHASE V/HO	WEIGHT LBS	DIMENSION IN	OPENING IN	CONTROL	NOTES
RF-1	EQB-27-50	AHU-2	INLINE	16,000	0.5	–	5 hp	–	BELT	208/3	–	–	–	INTERLOCK W/AHU-2	1,2,3,4,5,6,7
RF-2	EQB-27-50	AHU-3	INLINE	16,000	0.5	–	5 hp	–	BELT	208/3	–	–	–	INTERLOCK W/AHU-3	1,2,3,4,5,6,7

NOTES:

1. APPROVED EQUAL MANUFACTURER: COOK, PENN, ACME
2. IN-LINE DUCT MOUNTED FAN
3. ADJUSTABLE BELT DRIVE
4. DISCONNECT TO BE PROVIDED AND INSTALLED BY ELECTRICAL CONTRACTOR
5. PROVIDE MINIMUM 2 SETS OF BELTS
6. PROVIDE VARIABLE FREQUENCY DRIVE
7. PROVIDE TIME DELAY RELAY TO ALLOW OPERATION OF MOTORIZED DAMPERS

GENERAL FAN NOTES:

a. MOTOR STARTERS, DISCONNECTS (IF NOT FACTORY PROVIDED) AND ALL EQUIPMENT NORMAL POWER WIRING BY ELEC. CONTRACTOR

b. ALL CONTINUOUS-DUTY MOTORS SHALL BE PROVIDED WITH OVERLOAD PROTECTION ACCORDING TO NATIONAL ELECTRICAL CODE PAR. 430-32.

c. FIELD ADJUST OPENINGS WITH STRUCTURE.

DUCTLESS AIR CONDITIONING SPLIT SYSTEM SCHEDULE

MARK	MITSUBISHI MODEL		NOMINAL TONNAGE	TOTAL COOLING MBH	SENSIBLE COOLING MBH	TOTAL SUPPLY CFM	SEER	ENTRERING DB/WB °F	LEAVING DB/WB °F	VOLTAGE PHASE V/HO	MCA/MOCP AMPS		WEIGHT LBS		DIMENSIONS IN		NOTES
	OUTDOOR	INDOOR									OUTDOOR	INDOOR	OUTDOOR	INDOOR	OUTDOOR	INDOOR	
DSS-1	PUY-A24	PKA-A24	2.0	24.0	16.8	630	17.0	75/64	55/54	208/1	18/30	1.2/20	163	46	37x14x37	46x12x15	1,2,3,4,5,6,7,8,9,10,11,12

NOTES:

1. APPROVED EQUAL MANUFACTURER: DAIKIN, LG
2. COOLING CAPACITIES BASED ON STANDARD ARI CONDITIONS
3. HIGH SIDEWALL INDOOR UNIT
4. SUPPLY AIRFLOW CFM BASED ON HIGH SPEED AND DRY COIL
5. COOLING ONLY UNIT
6. PROVIDE LOW AMBIENT CONTROL
7. PROVIDE CONDENSATE PUMP
8. PROVIDE 1" THROWAWAY, MIN. 30% EFF. FILTER
9. PROVIDE HARD WIRED WALL MOUNTED CONTROLLER
10. PROVIDE FACTORY PROGRAMMABLE THERMOSTAT TO MATCH CAPACITY STAGES
11. PROVIDE REFRIGERANT LINES SIZE AS RECOMMENDED BY MANUFACTURER. FOR LONGER RUNS COORDINATE WITH MANUFACTURER PRIOR TO PURCHASE OR ANY WORK.
12. PROVIDE A SUCTION LINE ACCUMULATOR IF THE INSTALLED LINEAR LENGTH OF THE REFRIGERANT SUCTION LINES EXCEEDS 100 FT (FIELD VERIFY).

CENTRAL STATION AIR HANDLING UNIT SCHEDULE

SELECTION DATA					FAN DATA						COIL DATA (COOLING)						(HEATING)				GEN. DATA		
UNIT TAG	MANUFACTURER	MODEL NO.	S/A CFM	O/A CFM	TYPE	ESP ("WG)	HP	FLA	VOLTAGE	MCA/MOCP	ROWS/FPF	TOT./SENS MBH	EAT (DB/WB)	LAT (DB/WB)	WATER (ET/LT)	GPM	EWT/LWT	EAT/LAT	GPM	WPD	ROWS/FPF	OPERATING WEIGHT(LB)	DIMENSION LxWxH(IN)	NOTES
AHU-0	TRANE	MCC-30	12,000	2,800	PLENUM	2.0"	15	18.5	460/3Ø	23/40	4/122	415/319	79.2/65.6	55/54.2	42/54	68.9	180/160	42/56	18.5	4.20	1/80	3163	137X94X62	1 THRU 26
AHU-1	TRANE	MCC-35	16,000	4,000	PLENUM	2.0"	20	24.5	460/3Ø	30/50	4/130	564/431	79.5/65.8	55/54.2	42/54	93.6	180/160	41/56	26.4	5.76	1/80	4407	145X100X67	1 THRU 26
AHU-2	TRANE	MCC-35	16,000	4,000	PLENUM	2.5"	25	30.0	460/3Ø	38/60	4/130	564/431	79.5/65.8	55/54.2	42/54	95.8	180/160	41/56	26.4	5.76	1/80	4606	177X100X67	1 THRU 26
AHU-3	TRANE	MCC-35	16,000	4,000	PLENUM	2.5"	25	30.0	460/3Ø	38/60	4/130	564/431	79.5/65.8	55/54.2	42/54	95.8	180/160	41/56	26.4	5.76	1/80	4707	177X100X67	1 THRU 26
AHU-4	TRANE	MCC-40	20,000	4,500	PLENUM	2.5"	30	38.0	460/3Ø	47.5/80	4/122	707/530	79.1/65.6	55/54.1	42/54	117.8	180/160	42/56	31.7	7.75	1/80	5632	151X113X67	1 THRU 26

(*) EQUIVALENT MANUFACTURER: DAIKIN, JOHNSON CONTROLS

NOTES:

1. HORIZONTAL AIR HANDLING UNIT WITH TOP DISCHARGE AND TOP RETURN INLET
2. PROVIDE FILTER SECTION. MAXIMUM FILTER VELOCITY: 300 FPM
3. MAXIMUM COIL FACE VELOCITY 500 FPM
4. PROVIDE, IN ORDER: MIXING BOX, MAIN FILTER MEDIA, HEATING COIL, ACCESS SECTION, COOLING COIL, ACCESS SECTION, SUPPLY FAN WITH ACCESS DOOR.
5. PROVIDE 3-WAY MODULATING CONTROL VALVES.
6. PROVIDE MERV 8 MAIN FILTER
7. MOTOR STARTERS, DISCONNECTS (IF NOT FACTORY PROVIDED) AND ALL EQUIPMENT POWER WIRING BY ELEC. CONTRACTOR; COORDINATE PRIOR TO ANY WORK/PURCHASING
8. PROVIDE EXTENDED GREASE LINES TO MOTOR SIDE OF AHU.
9. WRAP AROUND COIL BY HEATPIPE TECHNOLOGIES.
10. PROVIDE SPRING VIBRATION ISOLATORS AS PER MANUFACTURER'S RECOMMENDATION.
11. PROVIDE A 10 FT. MINIMUM CLEARANCE FROM ALL VTR AND EXHAUST FANS TO OUTSIDE AIR INTAKES.
12. PROVIDE SMOKE DETECTORS IN SUPPLY AIR DUCT.
13. PROVIDE OSHA SAFETY GUARDS AS REQUIRED.
14. COILS SHALL NOT EXCEED 8 ROWS OR 120 FINS PER FOOT.
15. PROVIDE AHU's WITH EITHER RIGHT OR LEFT HAND COIL AND MOTOR CONNECTIONS AS INDICATED ON PLANS.
16. PROVIDE SOLID DOUBLE WALL CASING, WITH 1"/3 LB. INSULATION UNEXPOSED TO AIRSTREAM
17. PROVIDE 3-PHASE PROTECTION FOR EACH LEG OF ELEC. MOTOR
18. PROVIDE INTERFACE CONTROL COMPATIBLE WITH BAC SYSTEM
19. THE BAS SYSTEM SHALL BE CAPABLE TO SENSE AND AUTOMATICALLY OPEN ALL VAV BOXES 100% IF UNIT'S VFD IS IN BY-PASS MODE
20. PROVIDE 3" AUXILLARY DRAIN PAN WITH AUTOMATIC SHUT OFF FLOAT SWITCH.
21. PROVIDE VARIABLE FREQUENCY SPEED CONTROLLER
22. PROVIDE 6" CONCRETE PAD
23. PROVIDE SLOPED STAINLESS STEEL DRAIN PAN.
24. PROVIDE ANTI-MICROBIAL COATING FOR FILTERS AND DRAIN PAN ASSEMBLY.

HEAT PIPE SYSTEM (AHU-2&3):

1. MANUFACTURER HEAT PIPE TECHNOLOGY
2. PRE COIL 80° EAT AND 74° LAT
3. POST COIL 55° EAT AND 61° LAT
4. PROVIDE COIL WITH 3 ROWS, 12 FPI
5. MAX COIL VELOCITY 500 FPM
6. REFRIGERANT R-134A
7. PROVIDE SOLENOID VALVE
8. PROVIDE DRAIN PAN UNDER COIL
9. PROVIDE, IN ORDER: MIXING BOX, MAIN FILTER MEDIA, HEATING COIL, 24" HEAT PIPE SECTION WITH ACCESS DOOR, COOLING COIL WITH ACCESS FOOR, 24" HEAT PIPE SECTION WITH ACCESS DOOR, SUPPLY FAN WITH ACCESS DOOR.

VAV BOX SCHEDULE

SELECTION DATA						GEN. DATA	
UNIT TAG	MANUF. & MODEL	TYPE	INLET SIZE	MIN. CFM	MAX. CFM	VOLTAGE	NOTES
VAV-0-1	TITUS DESV	SINGLE	14	595	1980	277/1/60	1,2,3,4,5
VAV-0-2	TITUS DESV	SINGLE	14	630	2100	277/1/60	1,2,3,4,5
VAV-0-3	TITUS DESV	SINGLE	10	270	900	277/1/60	1,2,3,4,5
VAV-0-4	TITUS DESV	SINGLE	14	630	2100	277/1/60	1,2,3,4,5
VAV-0-5	TITUS DESV	SINGLE	10	270	900	277/1/60	1,2,3,4,5
VAV-1-1	TITUS DESV	SINGLE	12	420	1400	277/1/60	1,2,3,4,5
VAV-1-2	TITUS DESV	SINGLE	8	225	750	277/1/60	1,2,3,4,5
VAV-1-3	TITUS DESV	SINGLE	12	450	1500	277/1/60	1,2,3,4,5
VAV-1-4	TITUS DESV	SINGLE	12	465	1550	277/1/60	1,2,3,4,5
VAV-1-5	TITUS DESV	SINGLE	12	450	1500	277/1/60	1,2,3,4,5
VAV-1-6	TITUS DESV	SINGLE	8	135	450	277/1/60	1,2,3,4,5
VAV-1-7	TITUS DESV	SINGLE	14	525	1750	277/1/60	1,2,3,4,5
VAV-2-1	TITUS DESV	SINGLE	14	630	2100	277/1/60	1,2,3,4,5
VAV-2-2	TITUS DESV	SINGLE	14	520	1740	277/1/60	1,2,3,4,5
VAV-2-3	TITUS DESV	SINGLE	14	560	1880	277/1/60	1,2,3,4,5
VAV-2-4	TITUS DESV	SINGLE	14	520	1740	277/1/60	1,2,3,4,5
VAV-2-5	TITUS DESV	SINGLE	12	375	1250	277/1/60	1,2,3,4,5
VAV-2-6	TITUS DESV	SINGLE	12	400	1350	277/1/60	1,2,3,4,5
VAV-3-1	EXISTING	–	–	630	2100	–	–
VAV-3-2	EXISTING	–	–	520	1730	–	–
VAV-3-3	EXISTING	–	–	475	1580	–	–
VAV-3-4	EXISTING	–	–	555	1850	–	–
VAV-3-5	EXISTING	–	–	370	1240	–	–
VAV-3-6	EXISTING	–	–	405	1350	–	–
VAV-3-7	EXISTING	–	–	440	1460	–	–
VAV-4-1	TITUS DESV	SINGLE	10	330	1100	277/1/60	1,2,3,4,5
VAV-4-2	TITUS DESV	SINGLE	6	120	400	277/1/60	1,2,3,4,5
VAV-4-3	TITUS DESV	SINGLE	4	60	200	277/1/60	1,2,3,4,5
VAV-4-4	TITUS DESV	SINGLE	14	600	2000	277/1/60	1,2,3,4,5
VAV-4-5	TITUS DESV	SINGLE	4	60	200	277/1/60	1,2,3,4,5
VAV-4-6	TITUS DESV	SINGLE	8	135	460	277/1/60	1,2,3,4,5
VAV-4-7	TITUS DESV	SINGLE	12	330	1100	277/1/60	1,2,3,4,5
VAV-4-8	TITUS DESV	SINGLE	6	120	400	277/1/60	1,2,3,4,5
VAV-4-9	TITUS DESV	SINGLE	12	450	1500	277/1/60	1,2,3,4,5
VAV-4-10	TITUS DESV	SINGLE	8	210	700	277/1/60	1,2,3,4,5
VAV-4-11	TITUS DESV	SINGLE	6	120	400	277/1/60	1,2,3,4,5
VAV-4-12	TITUS DESV	SINGLE	12	500	1650	277/1/60	1,2,3,4,5
VAV-4-13	TITUS DESV	SINGLE	12	450	1500	277/1/60	1,2,3,4,5
VAV-4-14	TITUS DESV	SINGLE	10	330	1100	277/1/60	1,2,3,4,5

NOTES:

1. CONTROLS TO BE DDC, PROVIDE ROOM THERMOSTAT/SENSOR WITH OVERRIDE CAPABILITY.
2. POWER BY DIV. 16. CONTROL WIRING BY CONTROL CONTRACTOR. CONTROL POWER TRANSFORMER BY VAV MANUFACTURER.
3. FOR LONGER DUCT CONNECTION TO BOX THAN RECOMMENDED INLET RUN, MAKE THE TAP FOR BOXES AT THE MAIN DUCTWORK SIZED FOR MAIN STATIC PRESSURE LOSS. REDUCE TAP DOWN TO BOXES INLET SIZE JUST BEFORE CONNECTION AND PROVIDE MIN. LENGTH OF DUCT TO INLET AS RECOMMENDED BY MANUFACTURER FOR PROPER PRESSURE READING.
4. FOR BOXES WITH ELECTRIC HEATER, BOX SHALL BE FUSED BY MANUFACTURER IF REQUIRED MCA (AMPS) IS BELOW THE MIN. AVAILABLE SIZE OF COMMERCIAL BREAKER. CONTRACTOR SHALL COORDINATE PRIOR TO PURCHASING. PROVIDE ELECTRIC HEATER WITH MIN. 2 STAGES IF OVER 10 KW CAPACITY.
5. BOX ACTUATORS SHALL BE COMBINATION CONTROLLER-ACTUATOR WITH INTEGRATED, PROGRAMMABLE LOGIC

COORDINATION NOTE:

MECHANICAL CONTRACTOR SHALL COORDINATE ALL ELECTRICAL REQUIREMENTS AND ACCESSORIES WITH ELECTRICAL CONTRACTOR PRIOR TO PURCHASING AND INSTALLATION AND SHALL BRING ANY DISCREPANCIES TO THE ATTENTION OF ENGINEER

FAN POWERED TERMINAL UNIT SCHEDULE

SELECTION DATA				FAN DATA				HOT WATER COIL			GEN. DATA	
UNIT TAG	MANUF. & MODEL	TYPE	INLET SIZE	MAX. PRIMARY CFM	MIN. PRIMARY CFM	BLOWER PRIMARY CFM	HP	GPM	EWT/LWT	EAT/LAT	VOLTAGE	NOTES
PIU-0-1	TITUS DTQP-5	PARALLEL	14	1750	525	700	1/3	4.6	180/160	65/95	277/1/60	1,2,3,4
PIU-0-2	TITUS DTQP-4	PARALLEL	12	1400	420	560	1/3	3.6	180/160	65/95	277/1/60	1,2,3,4
PIU-0-3	TITUS DTQP-4	PARALLEL	10	1100	330	440	1/3	2.9	180/160	65/95	277/1/60	1,2,3,4
PIU-1-1	TITUS DTQP-4	PARALLEL	12	1250	375	500	1/3	3.3	180/160	65/95	277/1/60	1,2,3,4
PIU-1-2	TITUS DTQP-3	PARALLEL	8	600	180	240	1/4	1.6	180/160	65/95	277/1/60	1,2,3,4
PIU-1-3	TITUS DTQP-4	PARALLEL	12	1000	30	40	1/3	0.3	180/160	65/95	277/1/60	1,2,3,4
PIU-1-4	TITUS DTQP-2	PARALLEL	6	500	150	200	1/6	1.3	180/160	65/95	277/1/60	1,2,3,4
PIU-1-5	TITUS DTQP-4	PARALLEL	10	790	240	320	1/3	2.1	180/160	65/95	277/1/60	1,2,3,4
PIU-1-6	TITUS DTQP-2	PARALLEL	6	370	115	150	1/6	1.0	180/160	65/95	277/1/60	1,2,3,4
PIU-1-7	TITUS DTQP-3	PARALLEL	8	500	150	200	1/4	1.3	180/160	65/95	277/1/60	1,2,3,4
PIU-1-8	TITUS DTQP-5	PARALLEL	14	1800	540	720	1/3	4.7	180/160	65/95	277/1/60	1,2,3,4
PIU-1-9	TITUS DTQP-4	PARALLEL	10	1125	340	450	1/3	2.9	180/160	65/95	277/1/60	1,2,3,4
PIU-1-10	TITUS DTQP-4	PARALLEL	10	1050	315	420	1/3	2.7	180/160	65/95	277/1/60	1,2,3,4
PIU-1-11	TITUS DTQP-4	PARALLEL	10	875	265	350	1/3	2.3	180/160	65/95	277/1/60	1,2,3,4
PIU-2-1	TITUS DTQP-4	PARALLEL	12	1250	375	500	1/3	3.3	180/160	65/95	277/1/60	1,2,3,4
PIU-2-2	TITUS DTQP-4	PARALLEL	10	1000	300	400	1/3	2.6	180/160	65/95	277/1/60	1,2,3,4
PIU-2-3	TITUS DTQP-2	PARALLEL	6	400	120	140	1/6	1.0	180/160	65/95	277/1/60	1,2,3,4
PIU-2-4	TITUS DTQP-2	PARALLEL	6	600	180	240	1/6	1.6	180/160	65/95	277/1/60	1,2,3,4
PIU-2-5	TITUS DTQP-4	PARALLEL	10	860	258	344	1/6	2.2	180/160	65/95	277/1/60	1,2,3,4
PIU-2-6	TITUS DTQP-3	PARALLEL	8	690	207	276	1/4	1.8	180/160	65/95	277/1/60	1,2,3,4
PIU-2-7	TITUS DTQP-4	PARALLEL	10	800	240	320	1/3	2.1	180/160	65/95	277/1/60	1,2,3,4
PIU-2-8	TITUS DTQP-4	PARALLEL	12	1300	390	520	1/3	3.4	180/160	65/95	277/1/60	1,2,3,4
PIU-2-9	TITUS DTQP-4	PARALLEL	10	1000	300	400	1/3	2.6	180/160	65/95	277/1/60	1,2,3,4
PIU-3-1	TITUS DTQP-4	PARALLEL	12	1500	450	600	1/3	3.9	180/160	65/95	277/1/60	1,2,3,4
PIU-3-2	TITUS DTQP-4	PARALLEL	10	1000	300	400	1/3	2.6	180/160	65/95	277/1/60	1,2,3,4
PIU-3-3	TITUS DTQP-4	PARALLEL	12	1465	440	586	1/3	3.8	180/160	65/95	277/1/60	1,2,3,4
PIU-3-4	TITUS DTQP-3	PARALLEL	8	680	204	272	1/4	1.8	180/160	65/95	277/1/60	1,2,3,4
PIU-3-5	TITUS DTQP-3	PARALLEL	8	665	200	266	1/4	1.7	180/160	65/95	277/1/60	1,2,3,4
PIU-3-6	TITUS DTQP-3	PARALLEL	8	650	195	260	1/4	1.7	180/160	65/95	277/1/60	1,2,3,4
PIU-3-7	TITUS DTQP-4	PARALLEL	12	1300	390	520	1/3	3.4	180/160	65/95	277/1/60	1,2,3,4
PIU-3-8	TITUS DTQP-4	PARALLEL	12	1250	375	500	1/3	3.3	180/160	65/95	277/1/60	1,2,3,4
PIU-4-1	TITUS DTQP-6	PARALLEL	16	2300	690	920	3/4	6.0	180/160	65/95	277/1/60	1,2,3,4
PIU-4-2	TITUS DTQP-4	PARALLEL	10	1050	315	420	1/3	2.7	180/160	65/95	277/1/60	1,2,3,4
PIU-4-3	TITUS DTQP-3	PARALLEL	10	950	285	380	1/3	2.5	180/160	65/95	277/1/60	1,2,3,4
PIU-4-4	TITUS DTQP-3	PARALLEL	8	550	165	220	1/4	1.4	180/160	65/95	277/1/60	1,2,3,4
PIU-4-5	TITUS DTQP-3	PARALLEL	8	720	216	288	1/4	1.9	180/160	65/95	277/1/60	1,2,3,4
PIU-4-6	TITUS DTQP-2	PARALLEL	6	450	135	180	1/6	1.2	180/160	65/95	277/1/60	1,2,3,4
PIU-4-7	TITUS DTQP-3	PARALLEL	8	800	240	320	1/4	2.1	180/160	65/95	277/1/60	1,2,3,4
PIU-4-8	TITUS DTQP-3	PARALLEL	8	700	210	280	1/4	1.8	180/160	65/95	277/1/60	1,2,3,4
PIU-4-9	TITUS DTQP-3	PARALLEL	8	700	210	280	1/4	1.8	180/160	65/95	277/1/60	1,2,3,4
PIU-4-10	TITUS DTQP-3	PARALLEL	8	550	165	220	1/4	1.4	180/160	65/95	277/1/60	1,2,3,4
PIU-4-11	TITUS DTQP-3	PARALLEL	8	700	210	280	1/4	1.8	180/160	65/95	277/1/60	1,2,3,4
PIU-4-12	TITUS DTQP-3	PARALLEL	8	700	210	280	1/4	1.8	180/160	65/95	277/1/60	1,2,3,4
PIU-4-13	TITUS DTQP-2	PARALLEL	6	500	150	200	1/6	1.3	180/160	65/95	277/1/60	1,2,3,4
PIU-4-14	TITUS DTQP-5	PARALLEL	14	2000	600	800	1/3	5.2	180/160	65/95	277/1/60	1,2,3,4
PIU-4-15	TITUS DTQP-5	PARALLEL	14	2000	600	800	1/3	5.2	180/160	65/95	277/1/60	1,2,3,4

NOTES:

1. CONTROLS TO BE DDC, PROVIDE ROOM THERMOSTAT/SENSOR WITH OVERRIDE CAPABILITY
2. POWER BY DIV. 16. CONTROL WIRING BY CONTROL CONTRACTOR. CONTROL POWER TRANSFORMER BY VAV MANUFACTURER.
3. PROVIDE WITH ADJUSTABLE SCR FAN SPEED CONTROL
4. PROVIDE WITH SINGLE POINT ELECTRICAL CONNECTION

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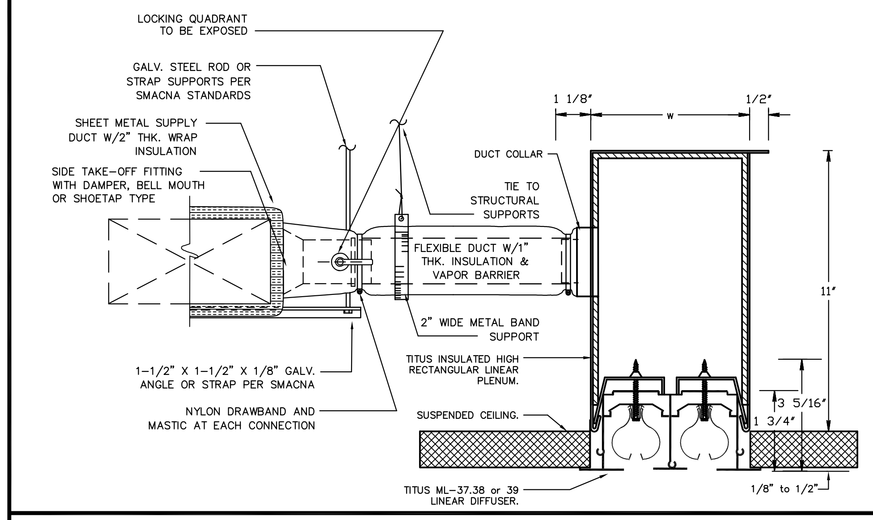
SHEET ISSUE:

NO.	DATE	DESCRIPTION	BY
	12/04/14	ISSUED FOR BID	
	01/21/15	ADDENDUM 3	

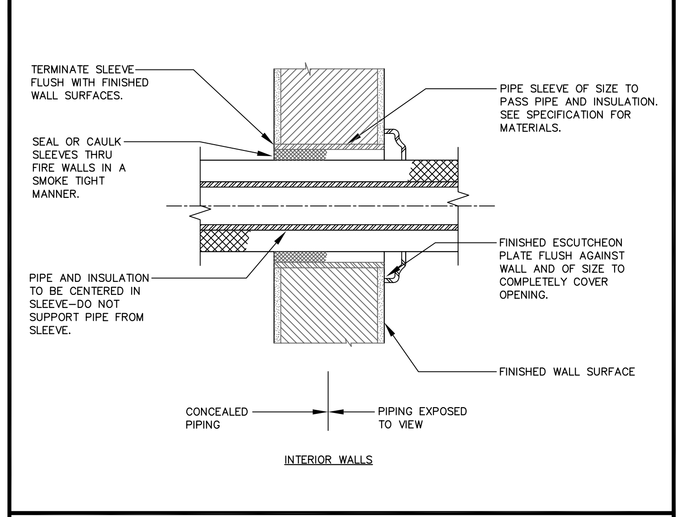
PRINCIPAL IN CHARGE: DPF
PROJECT ARCHITECT: -
DRAWN BY: GD

SHEET TITLE:
MECHANICAL SCHEDULES

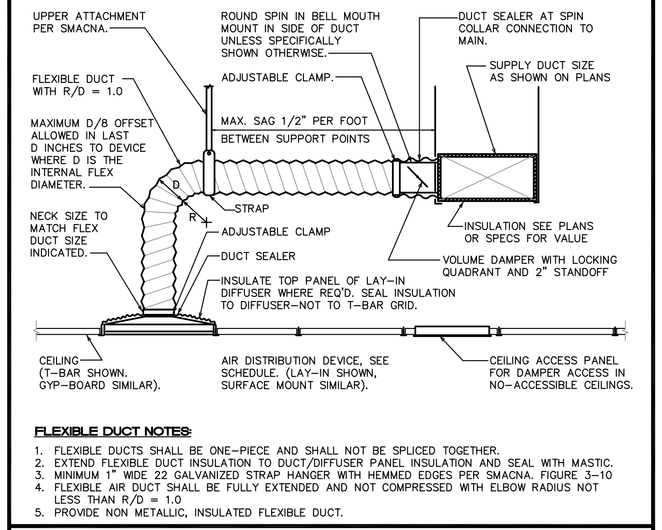
SHEET NO. M6.1
PROJ. NO. 013328.00


LOCKING QUADRANT TO BE EXPOSED
GALV. STEEL ROD OR STRAP SUPPORTS PER SMACNA STANDARDS
SHEET METAL SUPPLY DUCT W/2" THK. WRAP INSULATION
SIDE TAKE-OFF FITTING WITH DAMPER, BELL MOUTH OR SHOETAP TYPE
1 1/8"
W
1/2"
DUCT COLLAR
TIE TO STRUCTURAL SUPPORTS
FLEXIBLE DUCT W/1" THK. INSULATION & VAPOR BARRIER
2" WIDE METAL BAND SUPPORT
11"
1-1/2" X 1-1/2" X 1/8" GALV. ANGLE OR STRAP PER SMACNA
TITUS INSULATED HIGH RECTANGULAR LINEAR PLENUM.
NYLON DRAWBAND AND MASTIC AT EACH CONNECTION
SUSPENDED CEILING.
1 3/4"
1 3/16"
TITUS ML-37.38 or 39 LINEAR DIFFUSER.
1/8" to 1/2"

TYPICAL LINEAR DIFFUSER DETAIL
NOT TO SCALE


TERMINATE SLEEVE FLUSH WITH FINISHED WALL SURFACES.
PIPE SLEEVE OF SIZE TO PASS PIPE AND INSULATION. SEE SPECIFICATION FOR MATERIALS.
SEAL OR CAULK SLEEVES THRU FIRE WALLS IN A SMOKE TIGHT MANNER.
FINISHED ESCUTCHEON PLATE FLUSH AGAINST WALL AND OF SIZE TO COMPLETELY COVER OPENING.
PIPE AND INSULATION TO BE CENTERED IN SLEEVE-DO NOT SUPPORT PIPE FROM SLEEVE.
FINISHED WALL SURFACE
CONCEALED PIPING
PIPING EXPOSED TO VIEW
INTERIOR WALLS

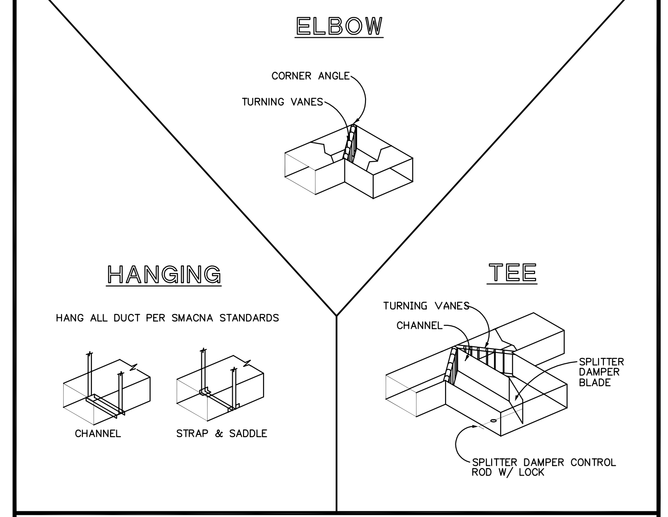
PIPE SLEEVE THRU WALL
NOT TO SCALE


UPPER ATTACHMENT PER SMACNA.
ROUND SPIN IN BELL MOUTH MOUNT IN SIDE OF DUCT UNLESS SPECIFICALLY SHOWN OTHERWISE.
DUCT SEALER AT SPIN COLLAR CONNECTION TO MAIN.
FLEXIBLE DUCT WITH R/D = 1.0
ADJUSTABLE CLAMP.
SUPPLY DUCT SIZE AS SHOWN ON PLANS
MAXIMUM D/8 OFFSET ALLOWED IN LAST D INCHES TO DEVICE WHERE D IS THE INTERNAL FLEX DIAMETER.
MAX. SAG 1/2" PER FOOT BETWEEN SUPPORT POINTS
D
R
STRAP
NECK SIZE TO MATCH FLEX DUCT SIZE INDICATED.
ADJUSTABLE CLAMP
DUCT SEALER
INSULATION SEE PLANS OR SPECS FOR VALUE
VOLUME DAMPER WITH LOCKING QUADRANT AND 2" STANDOFF
INSULATE TOP PANEL OF LAY-IN DIFFUSER WHERE REQ'D. SEAL INSULATION TO DIFFUSER-NOT TO T-BAR GRID.
CEILING (T-BAR SHOWN. GYP-BOARD SIMILAR).
AIR DISTRIBUTION DEVICE, SEE SCHEDULE. (LAY-IN SHOWN, SURFACE MOUNT SIMILAR).
CEILING ACCESS PANEL FOR DAMPER ACCESS IN NO-ACCESSIBLE CEILINGS.

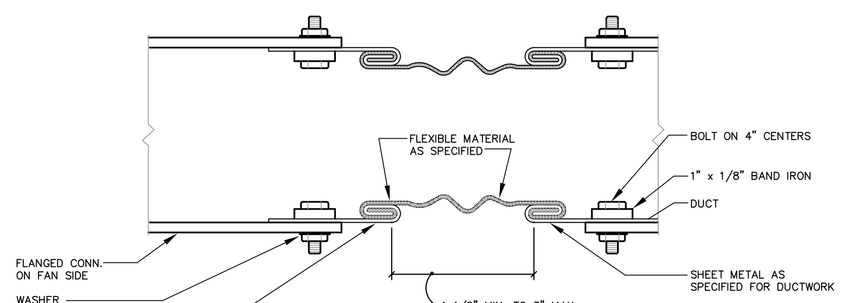
FLEXIBLE DUCT NOTES:

1. FLEXIBLE DUCTS SHALL BE ONE-PIECE AND SHALL NOT BE SPLICED TOGETHER.
2. EXTEND FLEXIBLE DUCT INSULATION TO DUCT/DIFFUSER PANEL INSULATION AND SEAL WITH MASTIC.
3. MINIMUM 1" WIDE 22 GALVANIZED STRAP HANGER WITH HEMMED EDGES PER SMACNA. FIGURE 3-10
4. FLEXIBLE AIR DUCT SHALL BE FULLY EXTENDED AND NOT COMPRESSED WITH ELBOW RADIUS NOT LESS THAN R/D = 1.0
5. PROVIDE NON METALLIC, INSULATED FLEXIBLE DUCT.

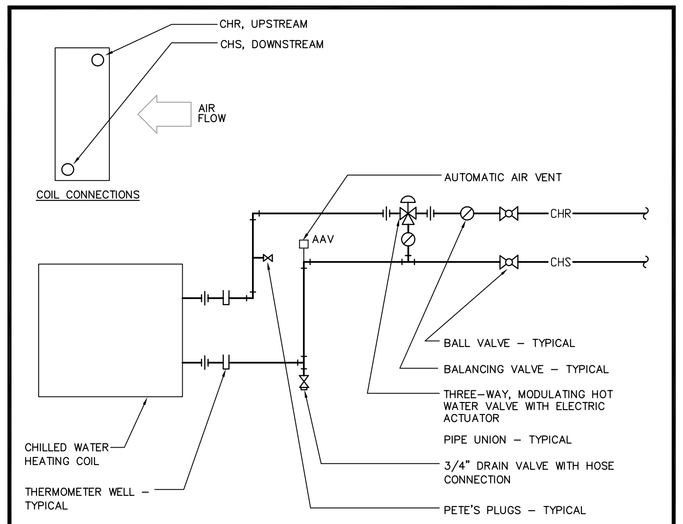
FLEXIBLE DUCT CONNECTION DETAIL
NOT TO SCALE



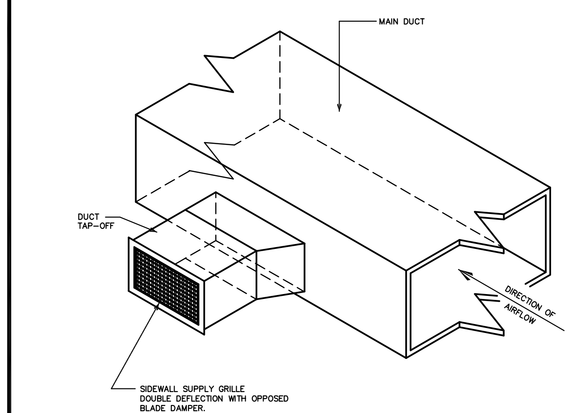
HVAC DUCT DETAILS
NOT TO SCALE


FLEXIBLE MATERIAL AS SPECIFIED
BOLT ON 4" CENTERS
1" x 1/8" BAND IRON
DUCT
FLANGED CONN. ON FAN SIDE
WASHER
SHEET METAL AS SPECIFIED FOR DUCTWORK
SHEET METAL AS SPECIFIED FOR DUCTWORK
1 1/2" MIN. TO 3" MAX. INSTALLED. 6" NORMAL WITH MAT. TAUT.

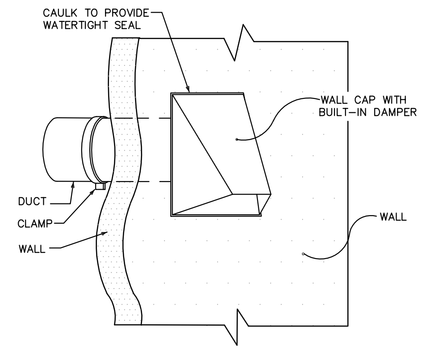
TYPICAL RECTANGULAR FLEXIBLE CONNECTION DETAIL
NOT TO SCALE



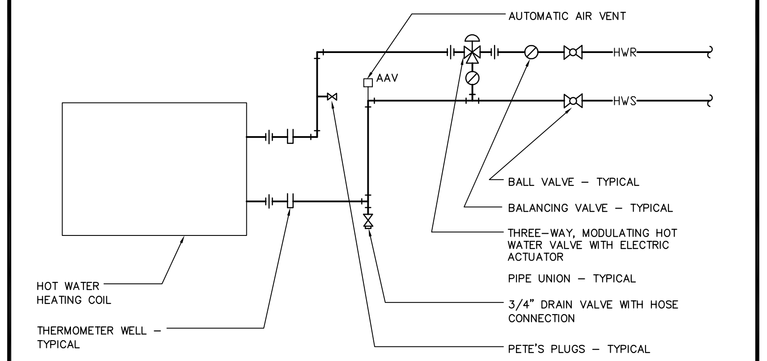
CHILLED WATER COIL PIPING
NOT TO SCALE



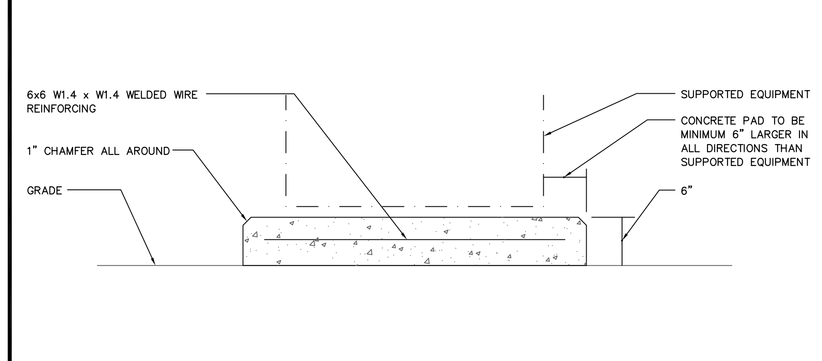
SIDEWALL GRILLE DETAIL
NOT TO SCALE



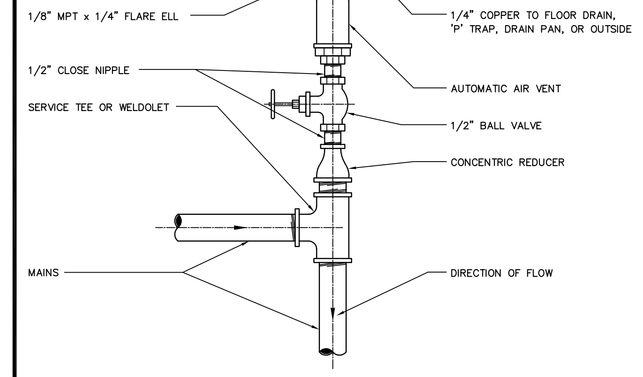
WALL CAP DETAIL
NOT TO SCALE



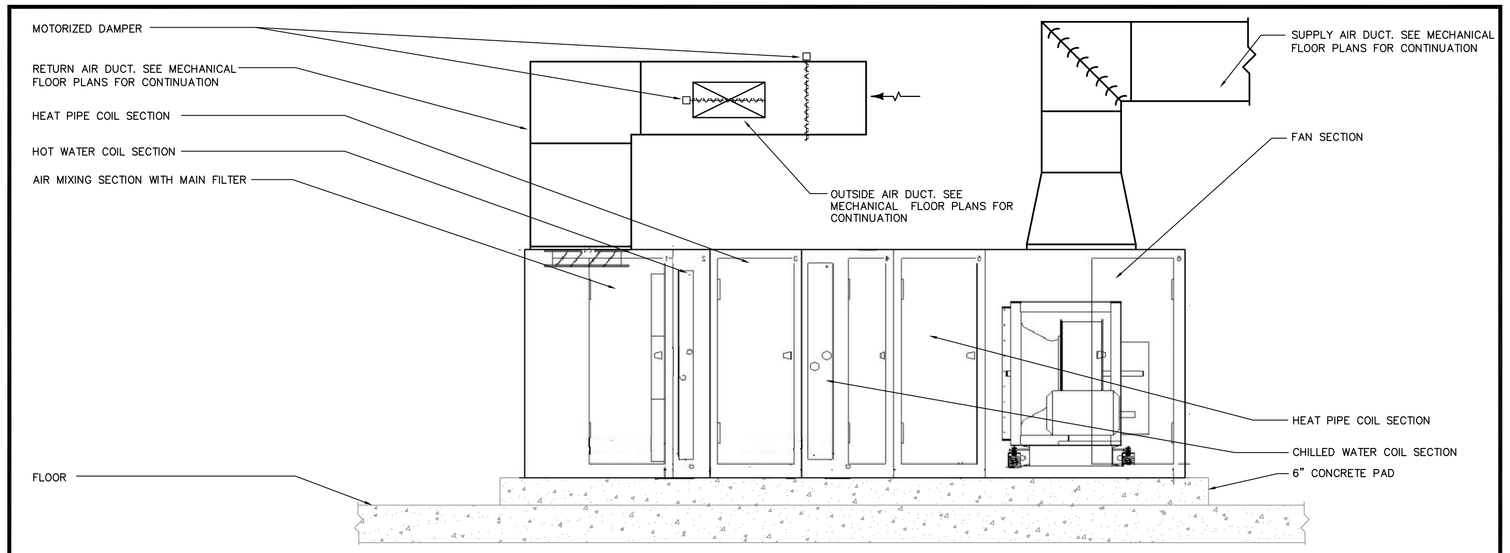
HOT WATER COIL PIPING
NOT TO SCALE


6x6 W1.4 x W1.4 WELDED WIRE REINFORCING
1" CHAMFER ALL AROUND
GRADE
SUPPORTED EQUIPMENT
CONCRETE PAD TO BE MINIMUM 6" LARGER IN ALL DIRECTIONS THAN SUPPORTED EQUIPMENT
6"

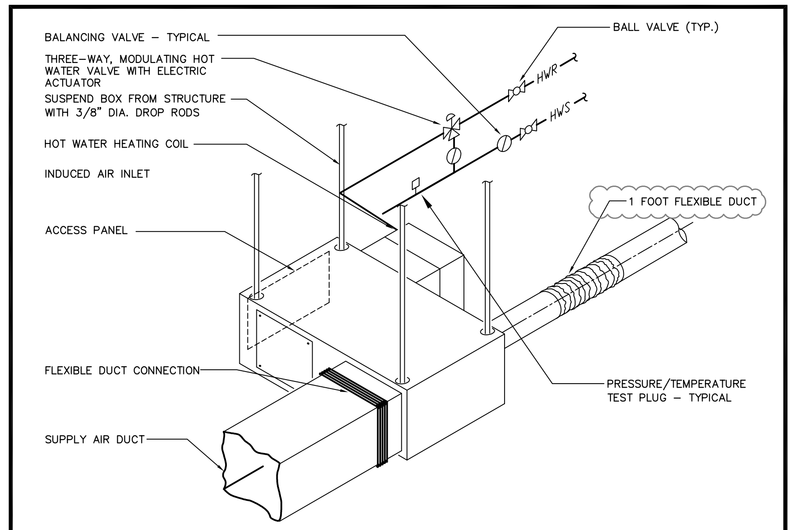
CONCRETE PAD DETAIL-INDOOR
NOT TO SCALE


1/8" MPT x 1/4" FLARE ELL
1/4" COPPER TO FLOOR DRAIN, 'P' TRAP, DRAIN PAN, OR OUTSIDE
1/2" CLOSE NIPPLE
AUTOMATIC AIR VENT
SERVICE TEE OR WELDOLET
1/2" BALL VALVE
CONCENTRIC REDUCER
MAINS
DIRECTION OF FLOW

AUTOMATIC AIR VENT DETAIL
NOT TO SCALE


MOTORIZED DAMPER
RETURN AIR DUCT. SEE MECHANICAL FLOOR PLANS FOR CONTINUATION
HEAT PIPE COIL SECTION
HOT WATER COIL SECTION
AIR MIXING SECTION WITH MAIN FILTER
SUPPLY AIR DUCT. SEE MECHANICAL FLOOR PLANS FOR CONTINUATION
FAN SECTION
OUTSIDE AIR DUCT. SEE MECHANICAL FLOOR PLANS FOR CONTINUATION
HEAT PIPE COIL SECTION
CHILLED WATER COIL SECTION
6" CONCRETE PAD
FLOOR

SECTION AT AHU-2
NOT TO SCALE



PIU UNIT DETAIL
NOT TO SCALE

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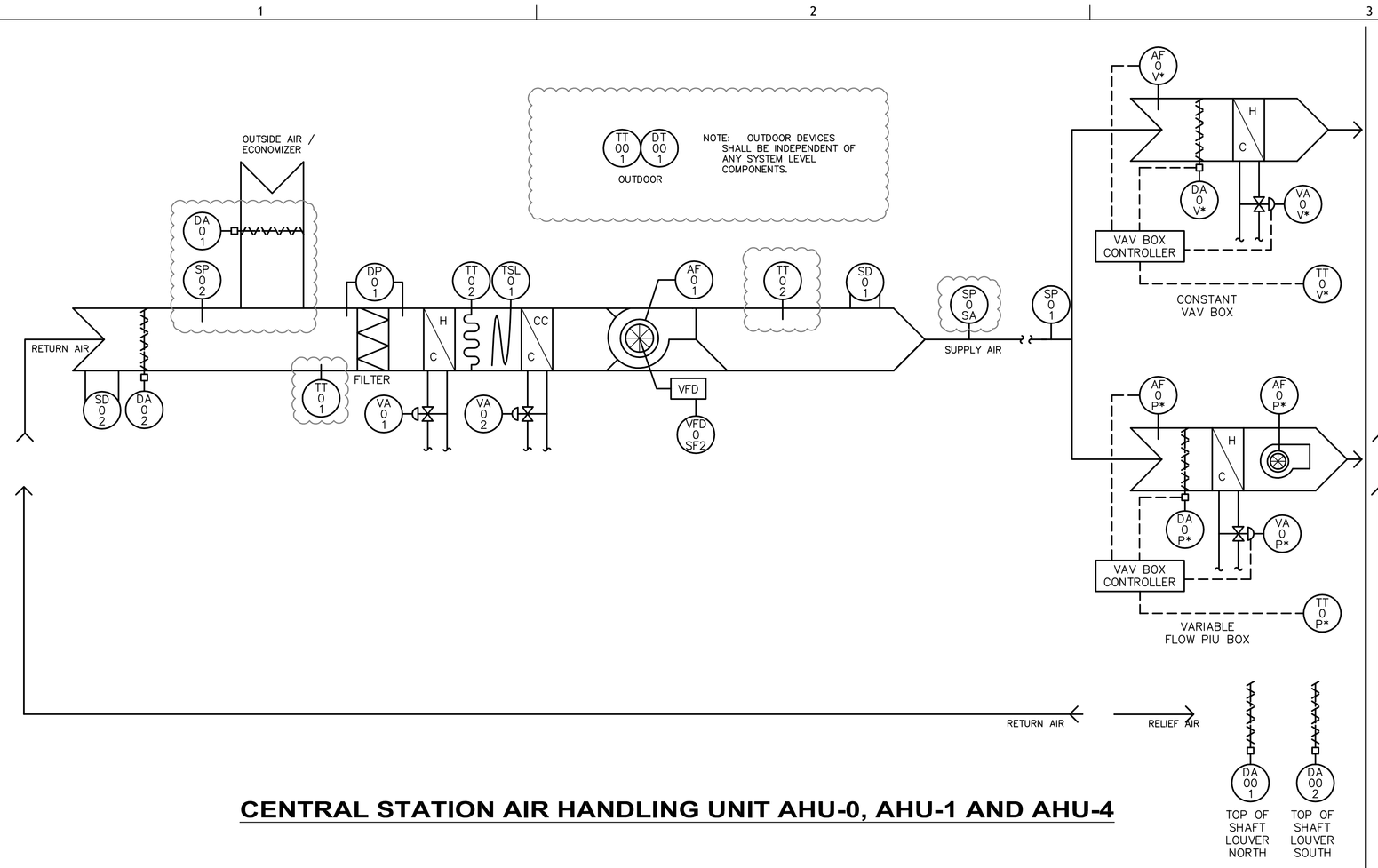
SHEET ISSUE:

NO.	DATE	DESCRIPTION	BY
	12/04/14	ISSUED FOR BID	
	01/21/15	ADDENDUM 3	

PRINCIPAL IN CHARGE: DPF
PROJECT ARCHITECT: -
DRAWN BY: GD

SHEET TITLE:
MECHANICAL DETAILS

SHEET NO. M7.1
PROJ. NO. 013328.00



CENTRAL STATION AIR HANDLING UNIT AHU-0, AHU-1 AND AHU-4

AA – TYPE NAME
BB – SYSTEM TAG (0 FOR AHU-0, 1 FOR AHU-1 AND 4 FOR AHU-4)
CC – ITEM NUMBER

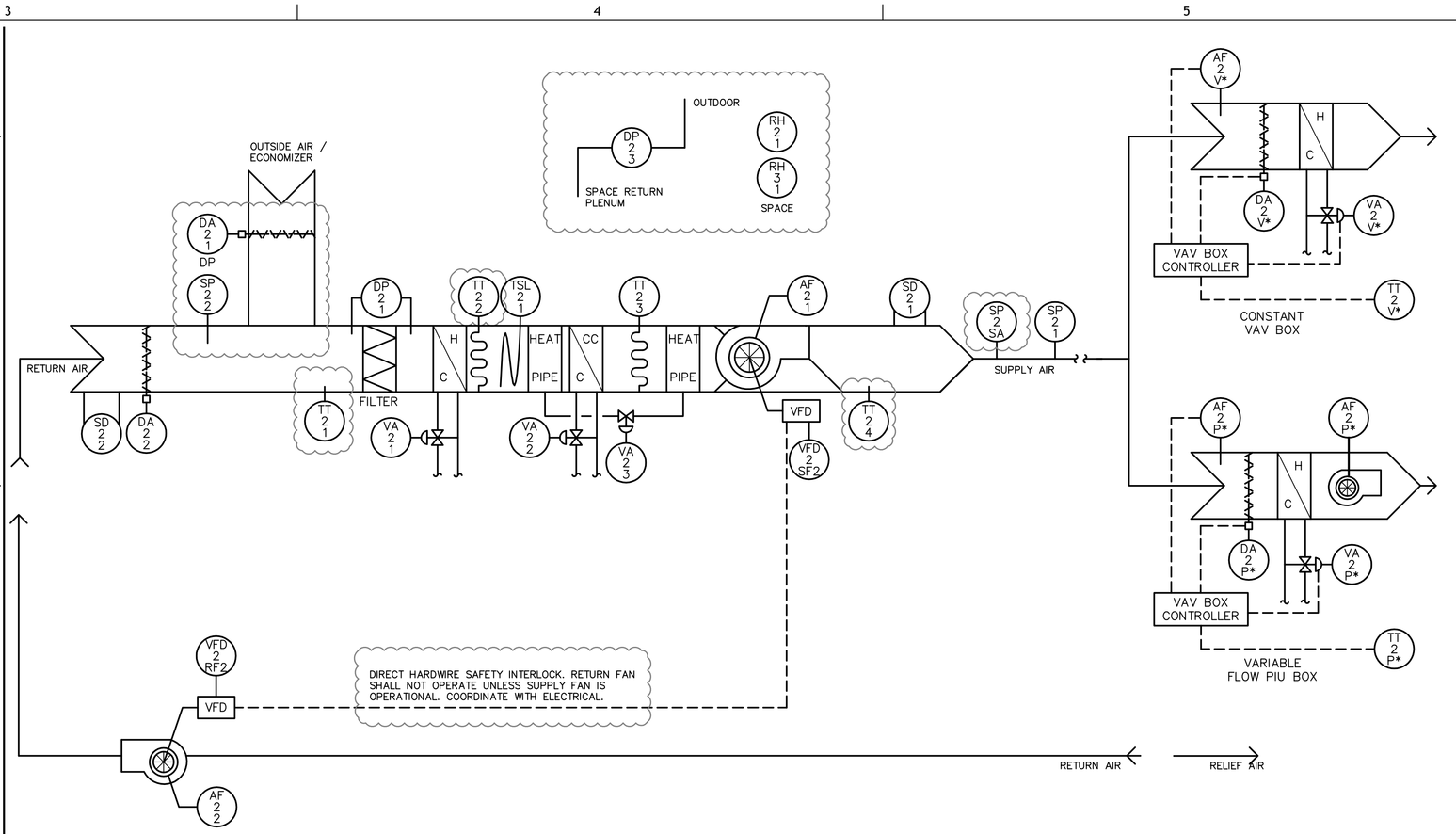
CONTROL DEVICE LIST

LOOP CONTROL FUNCTION	DEVICE	DEVICE FUNCTION	RANGE	REMARKS
MONITOR	TT-00-1	OUTSIDE AIR TEMPERATURE	0° TO 140° F	
MONITOR	DT-00-1	OUTSIDE DEWPOINT TEMPERATURE	10 TO 100	
ECONOMIZER / OUTSIDE AIR	DA-*-1	O/A DAMPER	MODULATING	FAIL NC
RETURN AIR	DA-*-2	R/A DAMPER	MODULATING	FAIL NO
OUTSIDE AIR CONTROL	SP-*-2	MIXED AIR PRESSURE	0 TO 4 IN WG	
SAFETY	SD-*-2	RETURN SMOKE DETECTOR	ON/OFF	
MONITOR	TT-*-1	MIXING AIR TEMPERATURE	40° TO 100° F	SINGLE POINT
MONITOR	DP-*-1	FILTER DIFFERENTIAL PRESSURE	0 TO 4 IN WG	
PRE-HEAT COIL	VA-*-1	MODULATING VALVE	MODULATING	FAIL NO
CHILLED WATER COIL	VA-*-2	MODULATING VALVE	MODULATING	FAIL NO
SAFETY	TSL-*-1	FREEZESTAT	-10° TO 40° F	AVERAGING
HOT WATER COIL	TT-*-2	COOLING COIL LEAVING AIR TEMP	40° TO 100° F	AVERAGING
FAN CONTROL	AF-*-1	SUPPLY AIR FLOW	0-20,000 CFM	
SUPPLY FAN CONTROL	VFD-*-SF2	SUPPLY FLOW CONTROLLER	MODULATING	
MONITOR	TT-*-3	SUPPLY AIR TEMPERATURE	40° TO 100° F	SINGLE POINT
SAFETY	SD-*-1	SUPPLY SMOKE DETECTOR	ON/OFF	
FAN CONTROL	SP-*-1	SUPPLY STATIC PRESSURE	0 TO 4 IN WG	
FAN SAFETY	SP-*-SA	SUPPLY STATIC PRESSURE	0 TO 12 IN WG	SET TO 4 IN WG
MONITOR	TT-*-V*	SPACE TEMPERATURE	0° TO 140° F	
MONITOR	AF-*-V*	SUPPLY AIR FLOW	0-20,000 CFM	
VAV CONTROL	DA-*-V*	VAV DAMPER	MODULATING	FAIL NC
HOT WATER COIL	VA-*-V*	MODULATING VALVE	MODULATING	FAIL NC
MONITOR	TT-*-P*	SPACE TEMPERATURE	0° TO 140° F	
–	AF-*-P*	SUPPLY AIR FLOW	0-20,000 CFM	
–	AF-*-P*	FAN CONTROLLER	ON/OFF	
VAV CONTROL	DA-*-P*	VAV DAMPER	MODULATING	FAIL NO
HOT WATER COIL	VA-*-P*	MODULATING VALVE	MODULATING	FAIL NC
RELIEF AIR	DA-00-1	RELIEF AIR DAMPER	MODULATING	FAIL NC
RELIEF AIR	DA-00-2	RELIEF AIR DAMPER	MODULATING	FAIL NC

NOTES:
1. SET POINTS ARE IDENTIFIED IN SEQUENCE OF OPERATION.
2. POWER BY DIV. 16. CONTROL WIRING BY CONTROL CONTRACTOR. CONTROL POWER TRANSFORMER BY PIU MANUFACTURER.
3. PROVIDE WITH ADJUSTABLE SCR FAN SPEED CONTROL
4. PROVIDE WITH SINGLE POINT ELECTRICAL CONNECTION
5. PROVIDE DDC CONTROLLER WITH WEB INTERFACE.
6. FAN SAFETY DEVICES SHALL BE HARDWIRED FOR FAN SHUTDOWN.

SEQUENCE OF OPERATION

See specifications for sequence of operation.



CENTRAL STATION AIR HANDLING UNIT AHU-2 AND AHU-3

AA – TYPE NAME
BB – SYSTEM TAG (2 FOR AHU-2 AND 3 FOR AHU-3)
CC – ITEM NUMBER

CONTROL DEVICE LIST

LOOP CONTROL FUNCTION	DEVICE	DEVICE FUNCTION	RANGE	REMARKS
MONITOR	TT-00-1	OUTSIDE AIR TEMPERATURE	0° TO 140° F	
MONITOR	DT-00-1	OUTSIDE DEWPOINT TEMPERATURE	10 TO 100	
ECONOMIZER / OUTSIDE AIR	DA-*-1	O/A DAMPER	MODULATING	FAIL NC
RETURN AIR	DA-*-2	R/A DAMPER	MODULATING	FAIL NO
OUTSIDE AIR CONTROL	SP-*-2	MIXED AIR STATIC PRESSURE	0 TO 4 IN WG	
SAFETY	SD-*-2	RETURN SMOKE DETECTOR	ON/OFF	
MONITOR	TT-*-1	MIXING AIR TEMPERATURE	40° TO 100° F	SINGLE POINT
MONITOR	DP-*-1	FILTER DIFFERENTIAL PRESSURE	0 TO 4 IN WG	
PRE-HEAT COIL	VA-*-1	MODULATING VALVE	MODULATING	FAIL NO
CHILLED WATER COIL	VA-*-2	MODULATING VALVE	MODULATING	FAIL NO
SAFETY	TSL-*-1	FREEZESTAT	-10° TO 40° F	AVERAGING
HOT WATER COIL	TT-*-2	COOLING COIL LEAVING AIR TEMP	40° TO 100° F	AVERAGING
CHILLED WATER COIL	TT-*-3	COOLING COIL LEAVING AIR TEMP	40° TO 100° F	AVERAGING
FAN CONTROL	AF-*-1	SUPPLY AIR FLOW	0-20,000 CFM	
SUPPLY FAN CONTROL	VFD-*-SF2	SUPPLY FLOW CONTROLLER	MODULATING	
MONITOR	TT-*-4	SUPPLY AIR TEMPERATURE	40° TO 100° F	SINGLE POINT
SAFETY	SD-*-1	SUPPLY SMOKE DETECTOR	ON/OFF	
FAN CONTROL	SP-*-1	SUPPLY STATIC PRESSURE	0 TO 4 IN WG	
FAN CONTROL	AF-*-2	RETURN AIR FLOW	0-20,000 CFM	
FAN SAFETY	SP-*-SA	SUPPLY STATIC PRESSURE	0 TO 12 IN WG	SET TO 4 IN WG
RETURN FAN CONTROL	VFD-2-RF2	RETURN FLOW CONTROLLER	MODULATING	
HEAT PIPE / COOLING CONTROL	RH-2-1	RELATIVE HUMIDITY	10 TO 100	
HEAT PIPE / COOLING CONTROL	RH-2-2	RELATIVE HUMIDITY	10 TO 100	
MONITOR	TT-*-V*	SPACE TEMPERATURE	0° TO 140° F	
MONITOR	AF-*-V*	SUPPLY AIR FLOW	0-20,000 CFM	
VAV CONTROL	DA-*-V*	VAV DAMPER	MODULATING	FAIL NC
HOT WATER COIL	VA-*-V*	MODULATING VALVE	MODULATING	FAIL NC
MONITOR	TT-*-P*	SPACE TEMPERATURE	0° TO 140° F	
–	AF-*-P*	SUPPLY AIR FLOW	0-20,000 CFM	
–	AF-*-P*	FAN CONTROLLER	ON/OFF	
VAV CONTROL	DA-*-P*	VAV DAMPER	MODULATING	FAIL NO
HOT WATER COIL	VA-*-P*	MODULATING VALVE	MODULATING	FAIL NC
FLOOR PRESSURE SENSOR	PS-*-1	FLOOR PRESSURE	0 TO 4" WG	
OUTDOOR PRESSURE SENSOR	PS-00-1	ATMOSPHERIC PRESSURE	0 TO 4" WG	

NOTES:
1. SET POINTS ARE IDENTIFIED IN SEQUENCE OF OPERATION.
2. POWER BY DIV. 16. CONTROL WIRING BY CONTROL CONTRACTOR. CONTROL POWER TRANSFORMER BY PIU MANUFACTURER.
3. PROVIDE WITH ADJUSTABLE SCR FAN SPEED CONTROL
4. PROVIDE WITH SINGLE POINT ELECTRICAL CONNECTION
5. PROVIDE DDC CONTROLLER WITH WEB INTERFACE.
6. FAN SAFETY DEVICES SHALL BE HARDWIRED FOR FAN SHUTDOWN.

SEQUENCE OF OPERATION

See specifications for sequence of operation.

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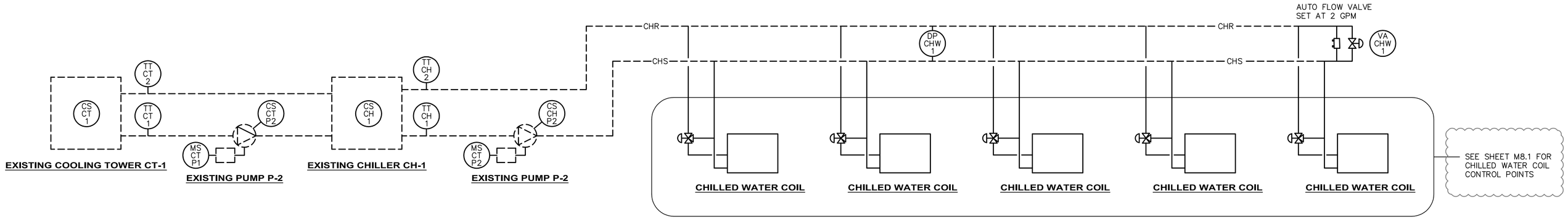
	01/21/15	ADDENDUM 3	

PRINCIPAL IN CHARGE: DPF
PROJECT ARCHITECT: -
DRAWN BY: GD

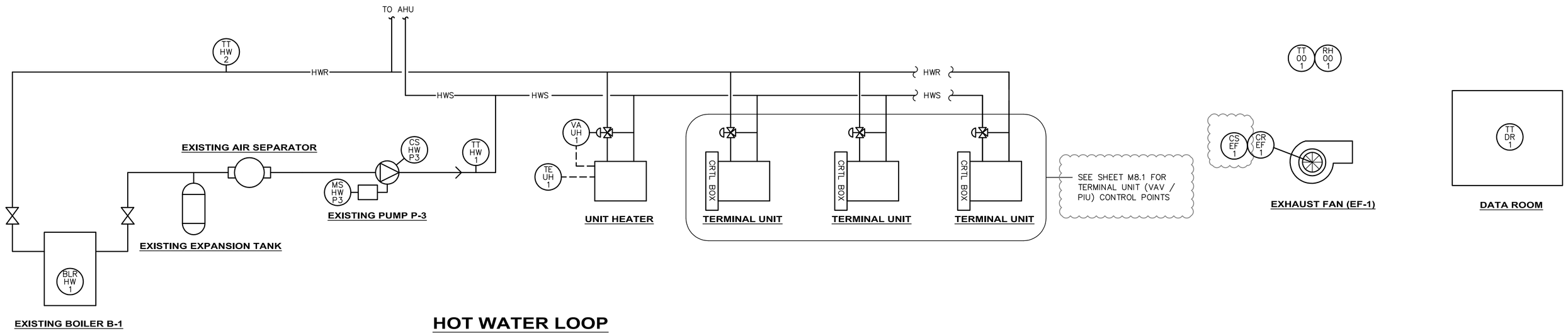
SHEET TITLE:
MECHANICAL CONTROL DIAGRAMS

SHEET NO.
M8.1

PROJ. NO.
013328.00



CHILLED WATER LOOP



HOT WATER LOOP

CONTROL DEVICE LIST (HOT WATER)

LOOP CONTROL FUNCTION	DEVICE	DEVICE FUNCTION	RANGE	REMARKS
BOILER	BLR–HW–1	BOILER	ON/OFF	
BOILER	TT–HW–1	HOT WATER SUPPLY TEMPERATURE	100° TO 200° F	
PUMP	MS–HW–P1	PRIMARY PUMP	ON/OFF	
MONITOR	CS–HW–P1	PUMP MOTOR CURRENT SWITCH	–	
UNIT HEATER	VA–UH–1	MODULATING VALVE	MODULATING	FAIL NO
UNIT HEATER	TE–UH–1	SPACE TEMPERATURE	40° TO 100° F	

NOTES:
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2. POWER BY DIV. 16. CONTROL WIRING BY CONTROL CONTRACTOR. CONTROL POWER TRANSFORMER BY PIU MANUFACTURER.
3. PROVIDE WITH ADJUSTABLE SCR FAN SPEED CONTROL
4. PROVIDE WITH SINGLE POINT ELECTRICAL CONNECTION
5. PROVIDE DDC CONTROLLER WITH WEB INTERFACE

CONTROL SYSTEM NOTES

SEE CONTROL SPECIFICATIONS AND SEQUENCE OF OPERATIONS FOR ADDITIONAL INFORMATION.

ALL DEVICES INDICATED SHALL BE NEW UNLESS INDICATED OTHERWISE.

CONTROL DEVICE LIST (CHILLED WATER)

LOOP CONTROL FUNCTION	DEVICE	DEVICE FUNCTION	RANGE	REMARKS
EXISTING COOLING TOWER	CS–CT–1	COOLING TOWER	ON/OFF	
EXISTING COOLING TOWER	TT–CT–1	COND. WATER SUPPLY TEMPERATURE	0° TO 100° F	
EXISTING COOLING TOWER	TT–CT–2	COND. WATER RETURN TEMPERATURE	0° TO 100° F	
EXISTING PUMP	MS–CT–P1	CONDENSER WATER PUMP	ON/OFF	
MONITOR	CS–CT–P1	PUMP MOTOR CURRENT SWTCH	–	
EXISTING CHILLER	CS–CH–1	CHILLER	ON/OFF	
EXISTING CHILLER	TT–CH–1	CHILLED WATER SUPPLY TEMPER.	0° TO 100° F	
EXISTING CHILLER	TT–CH–2	CHILLED WATER RETURN TEMPER.	0° TO 100° F	
EXISTING PUMP	MS–CH–P2	CONDENSER WATER PUMP	ON/OFF	
MONITOR	CS–CH–P2	PUMP MOTOR CURRENT SWTCH	–	
BYPASS VALVE	VA–CHW–1	MODULATING VALVE	MODULATING	FAIL NC

NOTES:
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3. PROVIDE WITH ADJUSTABLE SCR FAN SPEED CONTROL
4. PROVIDE WITH SINGLE POINT ELECTRICAL CONNECTION
5. PROVIDE DDC CONTROLLER WITH WEB INTERFACE

CONTROL DEVICE LIST

LOOP CONTROL FUNCTION	DEVICE	DEVICE FUNCTION	RANGE	REMARKS
MONITOR	TT–OO–1	OUTSIDE AIR TEMPERATURE	0° TO 140° F	
MONITOR	RH–OO–1	OUTSIDE RELATIVE HUMIDITY	10 TO 100	
EXHAUST FAN CONTROL	CR–EF–1	CONTROL RELAY	ON / OFF	
MONITOR	CS–EF–1	FAN MOTOR CURRENT SWITCH	OPEN / CLOSED	
MONITOR	TT–DR–1	DATA ROOM AIR TEMPERATURE	0° TO 140° F	

NOTES:
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PRINCIPAL IN CHARGE: DPF
PROJECT ARCHITECT: -
DRAWN BY: GD

SHEET TITLE:
MECHANICAL CONTROL DIAGRAMS

SHEET NO. M8.2

PROJ. NO. 013328.00

LIGHTING FIXTURE SCHEDULE

SYMBOL	LABEL	DESCRIPTION	LAMPS NO.	LAMPS TYPE	LAMPS WATT	BALLAST TYPE	VOLTAGE	MOUNTING	REMARKS
	A	2'x4' LINEAR FLUORESCENT FIXTURE. LITHONIA "2RT8S" SERIES	2	T8 4100K	32	HIGH FREQ. ELECTRONIC	277	CEILING RECESSED	1
		SAME AS ABOVE EXCEPT WIRED THRU ATS GENERATOR VIA BODINE RELAY.							
	B	4' LINEAR FLUORESCENT FIXTURE WITH WHITE FINISH. VOIGT "TIMO MINI" SERIES	1	T8 4100K	32	HIGH FREQ. ELECTRONIC	277	CEILING SUSPENDED	2
EM		SAME AS ABOVE EXCEPT WIRED THRU ATS GENERATOR VIA BODINE RELAY.							
	C	4' FLUORESCENT FIXTURE WITH DIRECT DISTRIBUTION AND WHITE FINISH. LITECONTROL "MOD 44" SERIES	2	T8 4100K	32	HIGH FREQ. ELECTRONIC	277	CEILING SUSPENDED	2
		SAME AS ABOVE EXCEPT WIRED THRU ATS GENERATOR VIA BODINE RELAY.							
	C2	4' FLUORESCENT FIXTURE WITH SEMI-INDIRECT DISTRIBUTION AND WHITE FINISH. LITECONTROL "MOD 44" SERIES	1	T8 4100K	32	HIGH FREQ. ELECTRONIC	277	CEILING SUSPENDED	2
		SAME AS ABOVE EXCEPT WIRED THRU ATS GENERATOR VIA BODINE RELAY.							
	D	4' LINEAR FLUORESCENT FIXTURE WITH 20/80 DISTRIBUTION AND ALUMINUM FINISH. PEERLESS "BHM4" SERIES	2	T8 4100K	32	HIGH FREQ. ELECTRONIC	277	CEILING SUSPENDED	2
		SAME AS ABOVE EXCEPT WIRED THRU ATS GENERATOR VIA BODINE RELAY.							
	E	6" FLUORESCENT DOWN LIGHT FIXTURE WITH CLEAR APERTURE AND WHITE FINISH. GOTHAM "AFV" SERIES	1	TRT	42	– –	277	CEILING RECESSED	1
EM		SAME AS ABOVE EXCEPT WIRED THRU ATS GENERATOR VIA BODINE RELAY.							
	FA	1'x4' FLUORESCENT WRAPAROND FIXTURE	2	T8 4100K	32	HIGH FREQ. ELECTRONIC	277	CEILING WALL	1
	F	8" FLUORESCENT PENDANT FIXTURE WITH SHORT HOUSING, STACKED RINGS, AND SATIN SILVER FINISH. GOTHAM "PDPF" SERIES	1	TRT 4100K	42	– –	277	CEILING SUSPENDED	2
	G	14" FLUORESCENT PENDANT FIXTURE WITH WHITE GLASS UPPER SHIELD AND SATIN SILVER FINISH. GOTHAM "PDPF" SERIES	3	TRT 4100K	42	– –	277	CEILING SUSPENDED	2
	H	8' LINEAR FLUORESCENT PENDANT FIXTURE WITH PARABOLIC LOUVER AND WHITE FINISH. FINELITE "S12-ID" SERIES	1	T8 4100K	32	– –	277	CEILING SUSPENDED	2
	J	4" FLUORESCENT PENDANT FIXTURE WITH WHITE GLASS AND SATIN SILVER FINISH. GOTHAM "PDPF" SERIES	1	TRT 4100K	32	– –	277	CEILING SUSPENDED	2
	OA	EXTERIOR HID WALL SCONCE WITH FLOOD UP/BEAM DOWN DISTRIBUTION AND WHITE FINISH. WET LOCATION RATED. US ARCHITECTURAL "LASER" SERIES	1	HID	70	– –	120	WALL/ SURFACE	2
	OB	OPEN FACE LED FIXTURE WITH OPEN GUARD. FINISH SELECTED BY ARCHITECT. LITHONIA "VGR1C" SERIES	1	LED 3500K	50	– –	277	WALL/CEILING SURFACE	2 3
EM		SAME AS ABOVE EXCEPT WIRED THRU ATS GENERATOR VIA BODINE RELAY.							
	S	4' FLUORESCENT INDUSTRIAL STRIP FIXTURE WITH WIRE GUARD AND WHITE FINISH. LITHONIA C SERIES	2	T8 4100K	32	HIGH FREQ. ELECTRONIC	277	CEILING SUSPENDED	4
	EX1	EDGE-LIT EXIT LIGHT FIXTURE WITH RED LETTERING, ALUMINUM HOUSING AND 90 MINUTE BATTERY BACKUP. LITHONIA "EDGR" SERIES	–	LED	–	– –	UNV	CEILING/ WALL	CUSTOMER AREAS
	EX2	EXIT LIGHT FIXTURE WITH RED LETTERING, DIE-CAST ALUMINUM HOUSING AND 90 MINUTE BATTERY BACKUP. LITHONIA "LE/LRE" SERIES	–	LED	–	– –	UNV	CEILING/ WALL	NON-CUSTOMER AREAS
	EX3	EXIT LIGHT FIXTURE WITH RED LETTERING, WHITE HOUSING AND 90 MINUTE BATTERY BACKUP. LITHONIA "LQM" SERIES	–	LED	–	– –	UNV	CEILING/ WALL	NON-CUSTOMER AREAS

1. VERIFY CEILING TYPES PRIOR TO ORDERING FIXTURES.
2. VERIFY EXACT MOUNTING HEIGHT WITH ARCHITECTURAL DRAWINGS.
3. PROVIDE FIXTURES WITH DAMP LOCATION RATING FOR ALL EXTERIOR LOCATIONS.
4. COORDINATE LOCATION AND MOUNTING HEIGHTS WITH MECHANICAL EQUIPMENT PRIOR TO ROUGH IN.

* CONTRACTOR IS RESPONSIBLE FOR SECURING ANY SUSPENDED LIGHT FIXTURE(S) WHICH SWAY OR MOVE DUE TO AIR PRODUCING MECHANICAL EQUIPMENT WITH RIGID SUPPORT(S).

FIRE ALARM NOTES

PART 1 – NOTES
1. A GENERAL ALARM SHALL BE ANNUNCIATED UPON ACTIVATION OF ANY INITIATION DEVICE INCLUDING; PULL STATION(S), FLOW SWITCH OR DETECTION DEVICE(S).
2. A TROUBLE SIGNAL SHALL BE ANNUNCIATED UPON FAILURE OR REMOVAL OF ANY DETECTION OR MANUAL DEVICE.
3. A SUPERVISORY SIGNAL SHALL BE ANNUNCIATED UPON ACTIVATION OF ANY FIRE SPRINKLER SYSTEM TAMPER SWITCH.
4. ALL FIRE ALARM SYSTEM DEVICES INSTALLED FOR THIS SPECIFIC PROJECT SHALL BE U.L. CERTIFIED.
5. ALL FIRE ALARM INITIATING DEVICES SHALL BE ADDRESSABLE AND ALL FIRE ALARM CIRCUITS SHALL BE CLASS "B", STYLE "C".
6. THE FIRE ALARM CONTRACTOR SHALL PROVIDE A DETAILED SET OF SHOP DRAWINGS (INCLUDING DEVICE CUT SHEETS), A COMPLETE POINT TO POINT WIRING DIAGRAM, FLOOR PLAN DRAWINGS INDICATING ALL DEVICE LOCATIONS AND NUMBERS, COMPLETE BATTERY CALCULATIONS AND COMPLETE NOTIFICATION APPLIANCE CIRCUIT CALCULATIONS (FOR THE SYSTEM TO BE INSTALLED) TO THE BUILDING DEPARTMENT (AUTHORITY HAVING JURISDICTION) AT THE TIME OF APPLICATION FOR BUILDING PERMIT.
7. PROVIDE THE OWNER WITH A COMPLETE FIRE ALARM SYSTEM AND INSTALLATION MANUAL, COVERING ALL SYSTEM EQUIPMENT INSTALLED FOR THIS PROJECT. KEEP AT THE MAIN FIRE ALARM CONTROL PANEL.
8. PROVIDE CERTIFICATE OF COMPLETION AT THE FINAL INSPECTION OF THE FIRE ALARM SYSTEM
9. ALL WORK SHALL BE PERFORMED IN ACCORDANCE WITH THE CURRENT EDITIONS OF NFPA 72 AND NATIONAL ELECTRICAL CODE.

PART 2 – EQUIPMENT
1. ALL NEW EQUIPMENT AND DEVICES SHALL BE U.L. LISTED FOR FIRE SERVICE AND SHALL BE COMPATIBLE WITH THE EXISTING SYSTEM IN USE.
2. THE FIRE ALARM SHALL BE CAPABLE OF FUTURE EXPANSION AS REQUIRED.
3. ROUTING OF THE FIRE ALARM SYSTEM CONDUIT IS DIAGRAMMATIC ONLY, VERIFY EXACT LOCATIONS PRIOR TO STARTING WORK.
4. ALL FIRE ALARM NOTIFICATION APPLIANCES SHALL ACTIVATE UPON INITIATION OF THE GENERAL ALARM.
5. ALL FIRE ALARM AUDIBLE SIGNALS IN OPEN AREA SHALL HAVE A THREE PLUS TEMPORAL PATTERN.
6. ALL FIRE ALARM AUDIBLE SIGNALS SHALL HAVE A SOUND LEVEL OF AT LEAST 15 dba ABOVE THE AVERAGE AMBIENT SOUND LEVEL.
7. MANUAL STATIONS TO BE INSTALLED AT 48" INCHES A.F.F.
8. MOUNT FIRE ALARM SYSTEM AUDIBLE/VISUAL SIGNALS (COMBINATION DEVICES) SUCH THAT THE ENTIRE STROBE LENS IS 80" A.F.F. OR 6" BELOW CEILING, WHICHEVER IS LOWER.
9. MOUNT FIRE ALARM SYSTEM STROBES SUCH THAT THE ENTIRE STROBE LENS IS 80" A.F.F. OR 6" BELOW CEILING, WHICH EVER IS LOWER.
10. SMOKE DETECTORS TO BE INSTALLED AS REQUIRED BY NFPA 72.
11. MOUNT FIRE ALARM MINI HORNS AT 80" A.F.F. OR 6" BELOW CEILING, WHICHEVER IS LOWER.
12. THE FIRE ALARM PANEL MUST HAVE AN EARTH GROUND CONNECTION AS REQUIRED BY THE SYSTEM MANUFACTURER, AND N.E.C. ARTICLE 760. MINIMUM WIRE SIZE IS #8 AWG FOR GROUND CONNECTION. (NOTE PANEL NEUTRAL OR CONDUIT GROUND IS NOT ACCEPTABLE).
13. HVAC DUCT SMOKE DETECTORS SHALL BE CONNECTED TO THE FIRE ALARM CONTROL PANEL AND SHALL INITIATE A SUPERVISORY SIGNAL ONLY.

PART 3 – WIRING
1. ALL WIRING AND CONDUIT TO CONFORM TO NFPA 72 AND NEC ARTICLE 760. WIRING SHALL BE SOLID COPPER OR STRANDED COPPER WITH A MAX. OF 7 STRANDS FOR 16 GA AND 18 GA, STRANDED COPPER WITH A MAXIMUM OF 19 STRANDS FOR SIZES 14 AND LARGER PER NEC 760 AND NFPA 70.
2. COLOR CODING MAY NOT APPLY TO EXISTING SYSTEMS, LABEL EXISTING WIRING ACCORDINGLY.

PART 4 – FIRE PROTECTION
1. ALL FIRE STOP PENETRATIONS SHALL BE MADE WITH APPROVED (NEC) METALLIC CONDUIT AND SHALL BE SEALED WITH A U.L. APPROVED FIRE STOP MATERIAL.

PART 5 – GENERAL NOTE:
NOTIFY THE STATE FIRE MARSHAL'S OFFICE VIA SFM FORM 354A, PRIOR TO BEGINNING OF INSTALLATION OF FIRE ALARM SYSTEM AND SUBMIT THREE COPIES OF COMPLETE INFORMATION REGARDING SYSTEM, IN COMPLIANCE WITH NFPA 72, NATIONAL FIRE ALARM AND SIGNALING CODE, 2013 EDITION, CHAPTERS 7 AND 10. **SPECIAL NOTE** EVIDENCE OF THE SYSTEM DESIGNER'S QUALIFICATIONS, IN THE FORM OF A NICET FIRE ALARM SYSTEM LEVEL IV CERTIFICATION; A SLATE OF GEORGIA LVA OR LVU LICENSE; OR AN EOR'S STAMP, SHALL BE IDENTIFIED ON THE PLANS, ALONG WITH THE APPROPRIATE NUMBER AND SIGNATURE (SEE CHAPTER 10, PARAGRAPH 10.5.1). AFTER APPROVAL, THE APPROVED PLANS MUST BE KEPT ON THE SITE AT ALL TIMES. NO WORK SHALL COMMENCE UNTIL APPROVAL OF THE PLANS SUBMITTAL BY SFM.

ELECTRICAL NOTES

PART 1 – GENERAL
A. REQUIREMENTS OF REGULATORY AGENCIES AND STANDARDS
1. ALL EQUIPMENT, MATERIAL AND INSTALLATION SHALL MEET THE REQUIREMENTS OF ONE OR MORE THE FOLLOWING:
   a. NATIONAL ELECTRICAL CODE (NEC) NFPA-70, LATEST EDITION AS ADOPTED BY THE AUTHORITY HAVING JURISDICTION
   b. LIFE SAFETY CODE (NFPA-101)
   c. OCCUPATIONAL SAFETY AND HEALTH ACT (OSHA)
   d. INTERNATIONAL BUILDING CODE 2012 EDITION
   d. STATE OF GEORGIA BUILDING CODE. (LOCAL AMENDMENTS TO INTERNATIONAL BUILDING CODE)
   e. NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)
   f. INTERNATIONAL ENERGY CONSERVATION CODE (IECC) 2009
   g. AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)
   h. INSTITUTE OF ELECTRICAL AND ELECTRONIC ENGINEERS (IEEE)
   i. ILLUMINATING ENGINEERING SOCIETY (IES)
   j. UNDERWRITERS LABORATORIES (UL)
   k. STANDARD FOR THE INSTALLATION, MAINTENANCE AND USE OF LOCAL PROTECTIVE SIGNALING SYSTEMS (NFPA-72)
   l. FEDERAL SPECIFICATION (FED. SPEC.)
   m.INSULATED POWER CABLE ENGINEERS ASSOCIATION (IPCEA)
B. SCOPE OF WORK
1. THE CONTRACTOR SHALL VISIT THE JOB SITE PRIOR TO BID TO BECOME FAMILIAR WITH THE PROJECT AND INTENT OF THE DRAWINGS.
2. THE CONTRACTOR SHALL OBTAIN A PERMIT FOR WORK TO BE COMPLETED AND INCLUDE COST FOR ALL PERMIT FEES, PERMITS, INSPECTIONS AND TESTING IN THE BID.
3. THE CONTRACTOR SHALL PROVIDE ALL NEW MATERIAL IN ACCORDANCE WITH THESE DOCUMENTS AND APPLICABLE SPECIFICATIONS.
4. THE CONTRACTOR SHALL REPORT ANY DISCREPANCIES BETWEEN THESE DOCUMENTS AND THOSE OF OTHER DISCIPLINES TO THE ARCHITECT/ENGINEER FOR WRITTEN DIRECTION/INSTRUCTIONS FOR CHANGES NECESSARY IN THE WORK.
5. THE CONTRACTOR SHALL NOT SCALE THE ELECTRICAL DRAWINGS, REFER TO THE ARCHITECTURAL DRAWINGS FOR EXACT LOCATIONS AND ELEVATIONS.
6. THE CONTRACTOR IS EXPECTED TO PROVIDE ALL MATERIAL NECESSARY FOR A COMPLETE OPERATING SYSTEM. IT IS NOT THE INTENT OF THESE DOCUMENTS TO SHOW EVERY MINOR DETAIL OF CONSTRUCTION.
7. THE CONTRACTOR SHALL COORDINATE THE ELECTRICAL WORK WITH OTHER TRADES AND MAKE PROPER PROVISIONS IN RELATION TO THEIR WORK. ANY CHANGES REQUIRED DUE TO LACK OF COORDINATION, SHALL BE MADE AT THE CONTRACTORS' EXPENSE.
8. THE CONTRACTOR SHALL BE RESPONSIBLE FOR CUTTING AND PATCHING OF THEIR WORK.
9. THE CONTRACTOR SHALL SUBMIT EQUIPMENT DATA AND SHOP DRAWINGS IN ELECTRONIC FORMAT AND AS DIRECTED BY GENERAL PROJECT REQUIREMENTS IN PROJECT MANUAL AS APPLICABLE. SUBMITTAL SHALL CONTAIN MATERIAL UTILIZED IN THE PROJECT FOR APPROVAL BY THE ARCHITECT/ENGINEER PRIOR TO BEGINNING ANY WORK OR ORDERING ANY MATERIAL. THE MATERIAL SHALL CONTAIN ALL ELECTRICAL EQUIPMENT INCLUDING SWITCH GEAR, PANELBOARDS, TRANSFORMERS, DISCONNECTS, SAFETY SWITCHES LIGHT FIXTURES, LIGHTING CONTROLS, WIRING DEVICES, COVER PLATES AND CONDUCTORS.
10. THE ELECTRICAL INSTALLATION SHALL BE INSTALLED IN A NEAT AND WORKMANLIKE MANNER BY A LICENSED ELECTRICAL CONTRACTOR.
11. THE CONTRACTOR SHALL PROVIDE INSURANCE FOR PROTECTION AGAINST PUBLIC LIABILITY AND PROPERTY DAMAGE FOR DURATION OF THE PROJECT.
C. TERMS
1. "PROVIDE", AS USED IN THE DOCUMENTS AND APPLICABLE SPECIFICATIONS MEANS TO FURNISH AND INSTALL COMPLETE.
2. "WIRING", AS USED IN THE DOCUMENTS MEANS CONDUIT AND WIRES WITHIN THE CONDUIT SYSTEM.
3. "CONCEALED", AS USED IN THE DOCUMENTS AND APPLICABLE SPECIFICATIONS MEANS EMBEDDED IN MASONRY OR OTHER CONSTRUCTION, BEHIND WALLS, INSIDE CABINETRY OR ABOVE SUSPENDED CEILINGS.
4. "NEMA 1", INDICATES THE ENCLOSURE SHALL BE LISTED FOR INDOOR USE ONLY.
5. "NEMA 3R", INDICATES THE ENCLOSURE SHALL BE LISTED FOR EXTERIOR USE.
D. WARRANTY
1. ALL MATERIAL AND WORK PERFORMED SHALL BE GUARANTEED FOR A PERIOD OF NOT LESS THAN ONE YEAR FROM DATE OF ACCEPTANCE.
2. ANY CORRECTIONS FOR DEFECTIVE MATERIALS AND/OR INSTALLATION SHALL BE MADE AT THE CONTRACTORS EXPENSE DURING THE WARRANTY PERIOD.

PART 2 – PRODUCTS
A. DISTRIBUTION AND BRANCH CIRCUIT PANEL BOARDS
1. CURRENT CARRYING BUSES AND GROUND BARS SHALL BE COPPER.
2. ALL CIRCUIT BREAKERS SHALL BE BOLT ON TYPE, PLUG ON TYPE CIRCUIT BREAKERS ARE NOT ACCEPTABLE.
3. ALL CIRCUIT BREAKERS USED FOR MECHANICAL EQUIPMENT SHALL BE "HACR" TYPE.
4. AIC RATINGS SHALL BE AS INDICATED ON THE BRANCH CIRCUIT PANEL SCHEDULES.
5. ALL PANEL BOARDS SHALL BE LABELED WITH PLASTIC LAMINATE IDENTIFICATION PLATES THAT ARE ENGRAVED WITH 1/4" LETTERING.
6. ALL PANEL BOARDS SHALL HAVE A TYPE WRITTEN SCHEDULE OF BRANCH CIRCUIT DESCRIPTIONS.
B. DISCONNECT SWITCHES AND MOTOR STARTERS
1. SWITCHES SHALL BE H.P. RATED, HEAVY DUTY TYPE.
2. QUICK-MAKE, QUICK-BREAK OPERATING MECHANISM.
3. STARTERS SHALL BE COMBINATION TYPE, FUSIBLE WITH BIMETAL OVERLOADS IN EACH PHASE.
4. STARTERS SHALL HAVE A "HAND-OFF-AUTO" (HOA) SWITCH.
C. CONDUCTORS
1. MINIMUM SIZE SHALL BE #12 AWG, EXCEPT FOR CONTROL/LOW VOLTAGE WIRING.
2. INSULATION TYPE SHALL BE THHN.
3. ALL CONDUCTORS SHALL BE COPPER.
D. WIRING DEVICES (GENERAL PURPOSE)/FACEPLATE
1. PAINTED WALL LOCATIONS, PROVIDE WHITE DEVICE WITH SMOOTH, WHITE NYLON FACEPLATE, UNLESS DIRECTED OTHERWISE.
2. WOOD STAINED AND TILED LOCATIONS, PROVIDE BLACK DEVICE WITH BRUSHED STAINLESS STEEL FACEPLATE, UNLESS DIRECTED OTHERWISE.
3. FOR EXTERIOR WALL LOCATIONS, PROVIDE ARLINGTON DBHR1W-1 OUTDOOR ELECTRICAL BOX OR EQUIVALENT WITH WEATHERPROOF COVER, COORDINATE COLOR WITH WALL FINISH.
E. JUNCTION BOXES
1. INTERIOR LOCATIONS SHALL BE PRESSED STEEL.
2. EXTERIOR LOCATIONS SHALL BE HEAVY DUTY CAST ALUMINUM WITH THREADED HUBS.
F. CONDUIT
1. EMT SHALL BE GALVANIZED STEEL.
2. PVC SHALL BE SCHEDULE 40 WHERE NOT SUBJECT TO PHYSICAL DAMAGE.
3. PVC SHALL BE SCHEDULE 80 WHERE EXPOSED TO PHYSICAL DAMAGE.
4. MC CABLE IS ACCEPTABLE WITH LIGHTWEIGHT ALUMINUM INTERLOCKED ARMOR AND INTERNAL REDUNDANT GROUND.

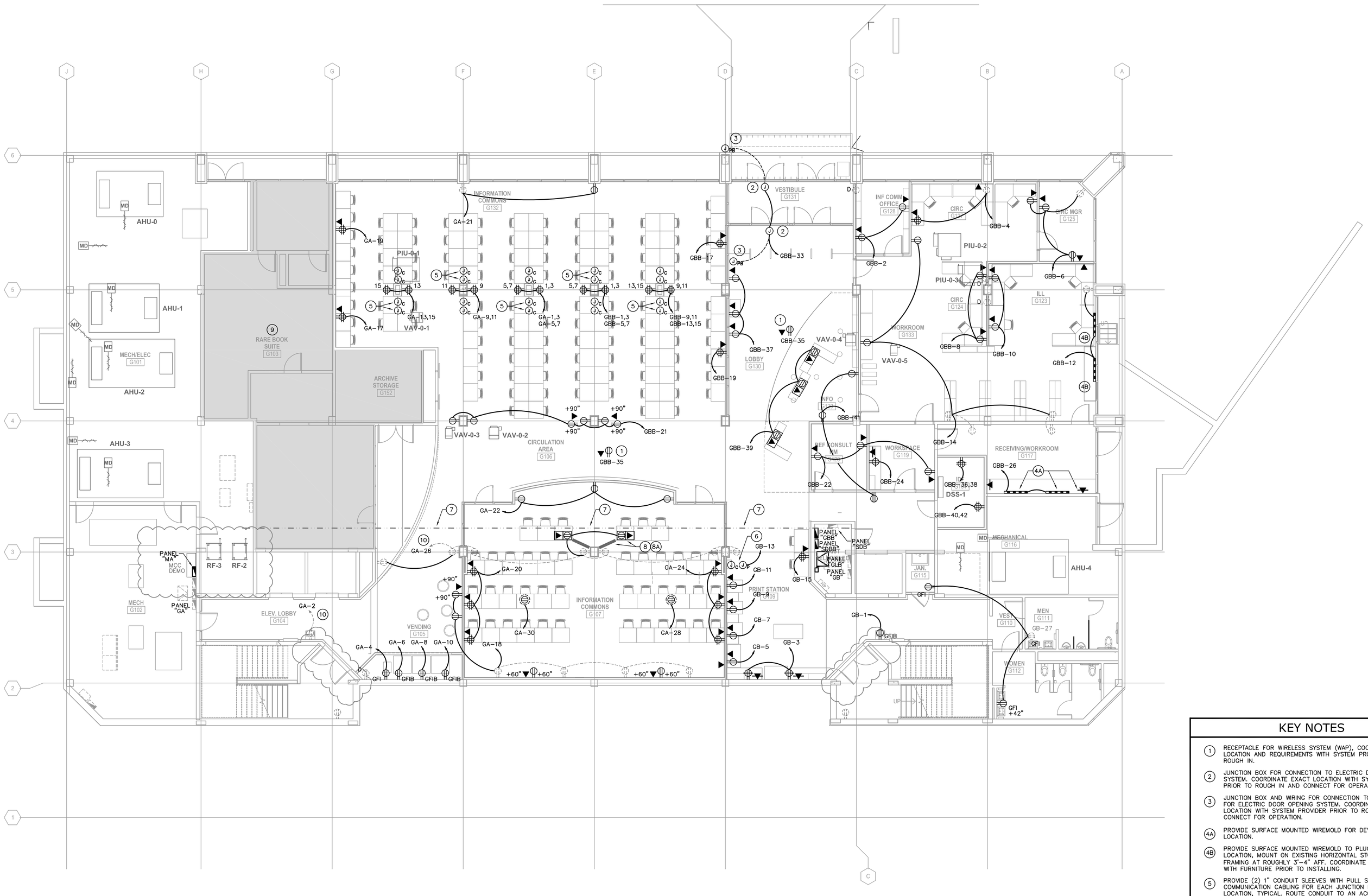
PART 3 – EXECUTION
A. COLOR CODING FOR CONDUCTORS SHALL BE THE FOLLOWING:
1. 208/120 VOLT, THREE PHASE, FOUR WIRE SYSTEM: A PHASE-BLACK, B PHASE-RED, C PHASE-BLUE, GROUNDED (NEUTRAL)-WHITE AND GROUNDING-GREEN.
2. 480/277 VOLT, THREE PHASE, FOUR WIRE SYSTEM: A PHASE-BROWN, B PHASE-PURPLE, C PHASE-YELLOW, GROUNDED (NEUTRAL)-GREY AND GROUNDING-GREEN.
3. CONDUCTORS FOR SERVICES AND BRANCH CIRCUITS #6 AND LARGER SHALL BE IDENTIFIED CONSISTENTLY BY: COLOR CODING, MARKING TAPE OR OTHER APPROVED MEANS.
B. WIRING METHODS
1. CONDUCTORS SHALL BE INSTALLED IN ELECTRICAL METALLIC TUBING (EMT) UNLESS NOTED OTHERWISE. CONNECTORS AND FITTINGS SHALL BE STEEL SET SCREW OR COMPRESSION TYPE.
2. PVC, AS INDICATED IN PART 2-PRODUCTS (F) SHALL BE INSTALLED BELOW SLAB, UNDERGROUND AND EXPOSED WHERE LISTED FOR SUCH USE.
3. MC CABLE, AS INDICATED IN PART 2-PRODUCTS (F) IS ACCEPTABLE FOR USE WITH GENERAL BRANCH CIRCUITS, RATED 20 AMPERES OR LESS, CONCEALED IN WALLS AND ABOVE SUSPENDED CEILINGS, AND AS APPROVED BY THE AUTHORITY HAVING JURISDICTION. IT IS NOT INTENDED TO USE MC CABLE EXPOSED.
4. INSTALLATIONS WITHIN HAZARDOUS (CLASSIFIED) LOCATIONS SHALL MEET ALL REQUIREMENTS FOR THE LOCATION PER NEC 500. PENETRATIONS INTO CLASSIFIED LOCATIONS SHALL BE PROVIDED WITH SEALS AND ALL RACEWAYS WITHIN CLASSIFIED LOCATIONS SHALL BE RIGID STEEL. ALL ELECTRICAL EQUIPMENT INSTALLED IN CLASSIFIED AREAS SHALL BE LISTED FOR USE WITHIN THE LOCATION.
C. MISCELLANEOUS
1. LAY-IN TYPE LIGHTING FIXTURES SHALL BE SECURED ON ALL FOUR SIDES TO SUSPENDED CEILING.
2. CONDUCTORS FOR BRANCH CIRCUITS SHALL BE INCREASED FROM SIZES INDICATED IN THE PANEL SCHEDULES TO PREVENT VOLTAGE DROP EXCEEDING 3% AT THE FARTHEST DEVICE. LOADS FOR DETERMINING CONDUCTOR SIZE SHALL BE BASED ON ACTUAL CONNECTED LOAD OR 80% OF CIRCUIT BREAKER SIZE, WHICH EVER IS GREATER. CONTACT ENGINEER OF RECORD FOR ALL CIRCUIT RUNS IN EXCESS OF 100 FT. FOR CALCULATION OF WIRE SIZE. FOR BID PURPOSES, INCREASE WIRE SIZE BY ONE FOR CIRCUIT RUNS BETWEEN 100 FT. AND 200 FT. AND TWO WIRE SIZES FOR CIRCUIT RUNS GREATER THAN 200 FT.
3. SHOP DRAWING AND SUBMITTAL REVIEW OF EQUIPMENT OR PRODUCTS OTHER THAN SPECIFIED MAY BE AT THE EXPENSE OF THE CONTRACTOR.
D. GROUNDING
1. THE ELECTRICAL SYSTEM SHALL BE COMPLETE AND EFFECTIVELY GROUNDED AS REQUIRED PER THE LATEST EDITION OF THE NEC AND LOCAL CODES. ALL GROUNDING ELECTRODE CONDUCTORS SHALL BE COPPER.
E. COORDINATION
1. THE CONTRACTOR SHALL COORDINATE WITH THE LOCAL UTILITY COMPANY PRIOR TO STARTING WORK FOR METERING REQUIREMENTS, METERING LOCATION, TRANSFORMER CONDUIT REQUIREMENTS, LUG SIZE REQUIREMENTS AND EXACT SERVICE POINT CONNECTION. SERVICE SHUT DOWN SHALL BE COORDINATED WITH THE OWNER PRIOR TO SCHEDULING WITH UTILITY COMPANY. CONTRACTOR SHALL INSTALL CONDUITS FOR UTILITY PRIMARY FEEDER PER UTILITY GUIDELINES.
2. THE CONTRACTOR SHALL COORDINATE WITH THE LOCAL TELEPHONE AND CABLE TV COMPANY PRIOR TO STARTING WORK FOR EXACT SERVICE POINT CONNECTION AND ANY REQUIREMENTS ANY ONE OF THE PROVIDERS MAY NEED.
3. THE CONTRACTOR SHALL COORDINATE WITH THE MECHANICAL DOCUMENTS AND MECHANICAL SUBMITTALS PRIOR TO PURCHASING ELECTRICAL EQUIPMENT. COORDINATE ALL CONTROL WIRING REQUIRED FOR ALL MECHANICAL EQUIPMENT RELATED TO THE PROJECT. PROVIDE ELECTRICAL BREAKERS, DISCONNECTS AND CONDUCTORS AS REQUIRED PER MECHANICAL SUBMITTALS AND ACTUAL EQUIPMENT NAMEPLATE RATINGS.
F. RECORD DOCUMENTS
1. THE CONTRACTOR SHALL MAINTAIN AN ACCURATE RECORD SET OF ANY DEVIATIONS BETWEEN THE WORK AS DESIGNED ON THESE DOCUMENTS AND THAT OF WHICH IS ACTUALLY INSTALLED. THIS RECORD SET OF DRAWINGS SHALL BE KEPT WITH THE GENERAL CONTRACTOR AND REQUIRE APPROVAL FROM THE ARCHITECT/ ENGINEER.

ELECTRICAL SHEET INDEX

SHEET#	DESCRIPTION
E0.1	ELECTRICAL NOTES
E2.0	PROPOSED LIGHTING PLAN-GROUND FLOOR
E2.1	PROPOSED LIGHTING PLAN-FIRST FLOOR
E3.0	PROPOSED POWER PLAN-GROUND FLOOR
E3.1	PROPOSED POWER PLAN-FIRST FLOOR
E3.2	PROPOSED POWER PLAN-SECOND FLOOR
E3.3	PROPOSED POWER PLAN-THIRD FLOOR
E3.4	PROPOSED POWER PLAN-FOURTH FLOOR
E5.1	EXISTING/DEMO ELECTRICAL RISER DIAGRAM
E5.2	ELECTRICAL RISER DIAGRAM
E6.1	ELECTRICAL PANEL SCHEDULES

ELECTRICAL SYMBOLS

	20 AMP DUPLEX RECEPTACLE (NEMA 5-20R) MOUNTED AT 18" A.F.F. TO CENTER LINE OF OUTLET UNLESS NOTED OTHERWISE.
	EXISTING DUPLEX OUTLET LOCATION, REMOVE DEVICE, PROVIDE NEW 20 AMP DUPLEX RECEPTACLE (NEMA 5-20R) AND COVER PLATE.
	20 AMP QUADRUPLEX RECEPTACLE (NEMA 5-20R) MOUNTED AT 18" A.F.F. TO CENTER LINE OF OUTLET UNLESS NOTED OTHERWISE.
GFI	20 AMP DUPLEX RECEPTACLE (NEMA 5-20R) WITH GROUND FAULT CIRCUIT INTERRUPTER, MOUNT AT 18" A.F.F. TO CENTER LINE OF OUTLET UNLESS NOTED OTHERWISE.
GFIB	20 AMP DUPLEX RECEPTACLE (NEMA 5-20R) GROUND FAULT CIRCUIT INTERRUPTER BY CIRCUIT BREAKER. MOUNT AT 18" A.F.F. TO CENTER LINE OF OUTLET UNLESS NOTED OTHERWISE.
GFI	20 AMP QUADRUPLEX RECEPTACLE (NEMA 5-20R) WITH GROUND FAULT CIRCUIT INTERRUPTER, MOUNT AT 18" A.F.F. TO CENTER LINE OF OUTLET UNLESS NOTED OTHERWISE.
CAB	20 AMP DUPLEX RECEPTACLE (NEMA 5-20R) MOUNTED IN CABINETRY, REFER TO ARCHITECTURAL ELEVATIONS FOR EXACT LOCATION AND MOUNTING HEIGHT.
CAB	20 AMP QUADRUPLEX RECEPTACLE (NEMA 5-20R) MOUNTED IN CABINETRY, REFER TO ARCHITECTURAL ELEVATIONS FOR EXACT LOCATION AND MOUNTING HEIGHT.
	20 AMP DUPLEX RECEPTACLE (NEMA 5-20R) MOUNTED ABOVE COUNTER SEE ARCHITECTUAL DRAWINGS FOR SPECIFIC REQUIREMENTS.
	20 AMP DUPLEX RECEPTACLE (NEMA 5-20R), RECESSED FLOOR MOUNTED. PROVIDE BRUSHED NICKEL FINISH COVER PLATE.
	FSR BOX, CEILING MOUNTED. KSU SPECIFICATION _____
	5' MULTI OUTLET HARD WIRED PLUG STRIP WITH USB CHARGING, 6" DEVICE SPACING, ALUMINIUM FINISH. MOUNT HIGH UP, UNDER COUNTER TOP UNLESS NOTED OTHERWISE.
NEMA	SPECIAL PURPOSE POWER DEVICE, COORDINATE EXACT NEMA NUMBER DEVICE WITH EQUIPMENT PLUG UNLESS NOTED OTHERWISE.
	COMMUNICATIONS OUTLET. PROVIDE 1" CONDUIT SLEEVE WITH PULL STRING, STUB INTO ACCESSIBLE CEILING SPACE. MOUNT AT 18" A.F.F. TO CENTER OF OUTLET UNLESS NOTED OTHERWISE.
CAB	COMMUNICATION OUTLET MOUNTED IN CABINETRY, REFER TO ARCHITECTURAL ELEVATIONS FOR EXACT LOCATION AND MOUNTING HEIGHT. PROVIDE 1" CONDUIT SLEEVE WITH PULL STRING, STUB INTO ACCESSIBLE CEILING SPACE.
	COMMUNICATIONS OUTLET. PROVIDE 1" CONDUIT SLEEVE WITH PULL STRING, STUB INTO ACCESSIBLE CEILING SPACE. MOUNTED ABOVE COUNTER TOP, REFER TO ARCHITECTURAL ELEVATIONS FOR EXACT LOCATION.
	COMMUNICATIONS OUTLET, FLOOR MOUNTED. PROVIDE 1" CONDUIT SLEEVE WITH PULL STRING, STUB INTO ACCESSIBLE CEILING SPACE. PROVIDE WIREMOLD 880MP FLOOR BOX WITH NICKEL COVER PLATE, CARPET FLANGE.
	TELEVISION OUTLET. PROVIDE 1" CONDUIT SLEEVE WITH PULL STRING, STUB INTO ACCESSIBLE CEILING SPACE. MOUNT AT 18" A.F.F. TO CENTER LINE OF OUTLET UNLESS NOTED OTHERWISE.
	TELEVISION OUTLET, CEILING MOUNTED.
J	JUNCTION BOX
$	SINGLE POLE, 20 AMP, SWITCH. MOUNT 42" A.F.F. TO CENTERLINE OF SWITCH UNLESS NOTED OTHERWISE.
$3	3-WAY, 20 AMP, SWITCH. MOUNT 42" A.F.F. TO CENTERLINE OF SWITCH UNLESS NOTED OTHERWISE.
$4	4-WAY, 20 AMP, SWITCH. MOUNT 42" A.F.F. TO CENTERLINE OF SWITCH UNLESS NOTED OTHERWISE.
$D	SINGLE POLE, 20 AMP, SWITCH WITH DIMMER. MOUNT 42" A.F.F. TO CENTERLINE OF SWITCH UNLESS NOTED OTHERWISE.
$3D	3-WAY DIMMER, 20 AMP, SWITCH. MOUNT 42" A.F.F. TO CENTERLINE OF SWITCH UNLESS NOTED OTHERWISE.
$OR	LIGHTING CONTROL OVERRIDE SWITCH. MATCH SWITCH WITH SYSTEM PROVIDED.
$M	SINGLE POLE, 20 AMP, MOTION ONLY SWITCH. MOUNT 42" A.F.F. TO CENTERLINE OF SWITCH UNLESS OTHERWISE NOTED. WATTSTOPPER "PW-100" SERIES. 225 SQ FT / 15' X 15' MAX
$MS	SINGLE/DOUBLE POLE, 20 AMP MOTION/SOUND SWITCH, PASSIVE (PIR) AND ULTRASONIC (US) DUAL TECHNOLOGY. MOUNT 42" A.F.F. TO CENTERLINE OF SWITCH UNLESS NOTED OTHERWISE. WATTSTOPPER "DW-100" SERIES. 225 SQ FT / 15' X 15' MAX
M	LINE VOLTAGE, PASSIVE ONLY MOTION SENSOR WITH 1200 SQ FT COVERAGE AERA WATTSTOPPER "CI-355" SERIES. 1200 SQ FT / 12' X 12' SQ / 8' MH
MS	LINE VOLTAGE, MOTION/SOUND SENSOR, PASSIVE (PIR) AND ULTRASONIC (US) DUAL TECHNOLOGY WITH 1000 SQ FT COVERAGE AREA WATTSTOPPER "DT-355" SERIES. 1000 SQ FT / 40' X 40' SQ / 78' MH?
MWP	LINE VOLTAGE, MOTION SENSOR, DAMP LOCATION RATED. WATTSTOPPER "HB350" SERIES. DUAL CIRCUIT "HB340"
MLVWP	LOW VOLTAGE MOTION SENSOR, PASSIVE (PIR), WET LOCATION RATED WATTSTOPPER "CB 100" SERIES.
MSLV	LOW VOLTAGE MOTION/SOUND SENSOR, PASSIVE (PIR) AND ULTRASONIC (US) DUAL TECHNOLOGY WITH 1000 SQ FT COVERAGE AREA WATTSTOPPER "DT-300" SERIES. 1000 SQ FT / 40' X 40' SQ / 78' MH?
PP	SELF CONTAINED, PLENUM RATED, DUAL CIRCUIT POWER PACK WITH 20 AMP RATING. WATTSTOPPER "BZ-150" SERIES. -
	ELECTRICAL PANELBOARD
ACB	FUSIBLE DISCONNECT SWITCH A = POLES, B= FRAME SIZE, C= FUSE RATING
ACB	FUSIBLE DISCONNECT SWITCH TYPE COMBINATION MOTOR STARTER A = POLES, B= NEMA SIZE, C= FUSE RATING
	GROUNDING ELECTRODE AND CONDUCTOR SYSTEM
	TRANSFORMER
	TELEPHONE WOOD BACKBOARD
EF	EXHAUST FAN. SEE MECHANICAL



1 E3.0 POWER PROPOSED PLAN - GROUND FLOOR

1/8" = 1'-0"

KEY NOTES

1. RECEPTACLE FOR WIRELESS SYSTEM (WAP), COORDINATE EXACT LOCATION AND REQUIREMENTS WITH SYSTEM PROVIDER PRIOR TO ROUGH IN.
2. JUNCTION BOX FOR CONNECTION TO ELECTRIC DOOR OPENING SYSTEM. COORDINATE EXACT LOCATION WITH SYSTEM PROVIDER PRIOR TO ROUGH IN AND CONNECT FOR OPERATION.
3. JUNCTION BOX AND WIRING FOR CONNECTION TO PUSH BUTTON FOR ELECTRIC DOOR OPENING SYSTEM. COORDINATE EXACT LOCATION WITH SYSTEM PROVIDER PRIOR TO ROUGH IN AND CONNECT FOR OPERATION.
4A. PROVIDE SURFACE MOUNTED WIREMOLD FOR DEVICES IN THIS LOCATION.
4B. PROVIDE SURFACE MOUNTED WIREMOLD TO PLUG STRIP IN THIS LOCATION, MOUNT ON EXISTING HORIZONTAL STORE FRONT FRAMING AT ROUGHLY 3'-4" AFF. COORDINATE EXACT LOCATION WITH FURNITURE PRIOR TO INSTALLING.
5. PROVIDE (2) 1" CONDUIT SLEEVES WITH PULL STRING FOR COMMUNICATION CABLING FOR EACH JUNCTION BOX AT THIS LOCATION, TYPICAL. ROUTE CONDUIT TO AN ACCESSIBLE CEILING FOR FUTURE USE.
6. JUNCTION BOXES FOR CASH MACHINE, MOUNT AT 18" SIDE BY SIDE HORIZONTAL, SHOWN AS INDICATED FOR CLARITY. PROVIDE CONNECTION TO UNIT AS REQUIRED.
7. APPROXIMATE ROUTING OF EXISTING FIBER CABLING. CONTRACTOR TO PROTECT CABLE SO IT IS NOT REMOVED NOR DAMAGED DURING CONSTRUCTION.
8. PROPOSED ROUTING OF BRANCH WIRING UNDER SLAB FOR FLOOR BOX POWER. RECEPTACLE FLOOR BOX COVER TO BE INTERCHANGEABLE WITH A THREADED HUB FOR BRANCH WIRING WHIP TO TABLE POWER DEVICES, IF REQUIRED, TYPICAL OF TWO.
8A. PROPOSED ROUTING OF COMMUNICATION CONDUIT UNDER SLAB FOR COMMUNICATION FLOOR BOX, TYPICAL.
9. CONTRACTOR TO RELOCATE EXISTING ALARM PANEL FROM THE EXISTING VAULT BEING REMOVED TO THIS RARE BOOKS ROOM AS NEEDED. COORDINATE EXACT LOCATION OF SYSTEM AND RECONNECT FOR OPERATION.
10. EXISTING BRANCH CIRCUIT WIRING TO REMAIN, RELOCATE TO CIRCUIT BREAKER LOCATION AS INDICATED AND CONNECT FOR OPERATION.

GENERAL NOTE

REFER TO SHEET E6.1, MECHANICAL EQUIPMENT SCHEDULE, FOR POWER REQUIREMENTS TO ALL MECHANICAL EQUIPMENT ON THIS SHEET.

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SHEET ISSUE:

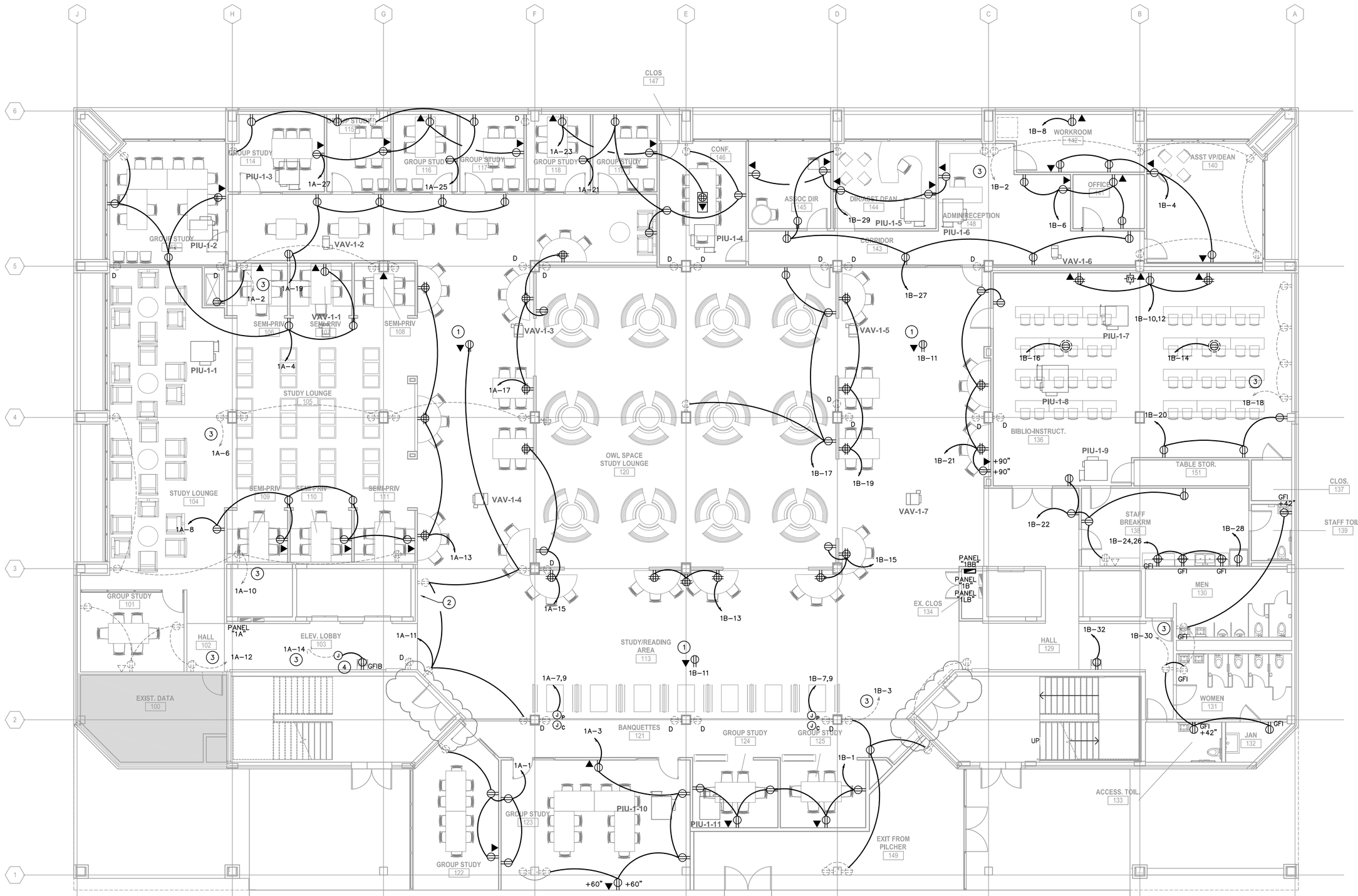
NO.	DATE	DESCRIPTION	BY
	12/04/14	ISSUED FOR BID	
	01/21/15	ADDENDUM 3	

PRINCIPAL IN CHARGE: DPF
PROJECT ARCHITECT:
DRAWN BY: GD

SHEET TITLE:
PROPOSED POWER PLAN - GROUND FLOOR

SHEET NO. E3.0

PROJ. NO. 013328.00



1 E3.1 PROPOSED POWER PLAN - FIRST FLOOR

1/8" = 1'-0"

KEY NOTES

1. RECEPTACLE FOR WIRELESS SYSTEM (WAP). COORDINATE EXACT LOCATION AND REQUIREMENTS WITH SYSTEM PROVIDER PRIOR TO ROUGH IN.
2. LOCATION OF EXISTING DIGITAL BOARD. EXISTING POWER AND COMMUNICATION TO REMAIN.
3. EXISTING BRANCH CIRCUIT WIRING TO REMAIN. RELOCATE TO CIRCUIT BREAKER LOCATION AS INDICATED AND CONNECT FOR OPERATION.
4. INTERCEPT EXISTING BRANCH CIRCUIT WIRING AND CONNECT FOR OPERATION.

GENERAL NOTE

REFER TO SHEET E6.1, MECHANICAL EQUIPMENT SCHEDULE, FOR POWER REQUIREMENTS TO ALL MECHANICAL EQUIPMENT ON THIS SHEET.

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NO.	DATE	DESCRIPTION	BY
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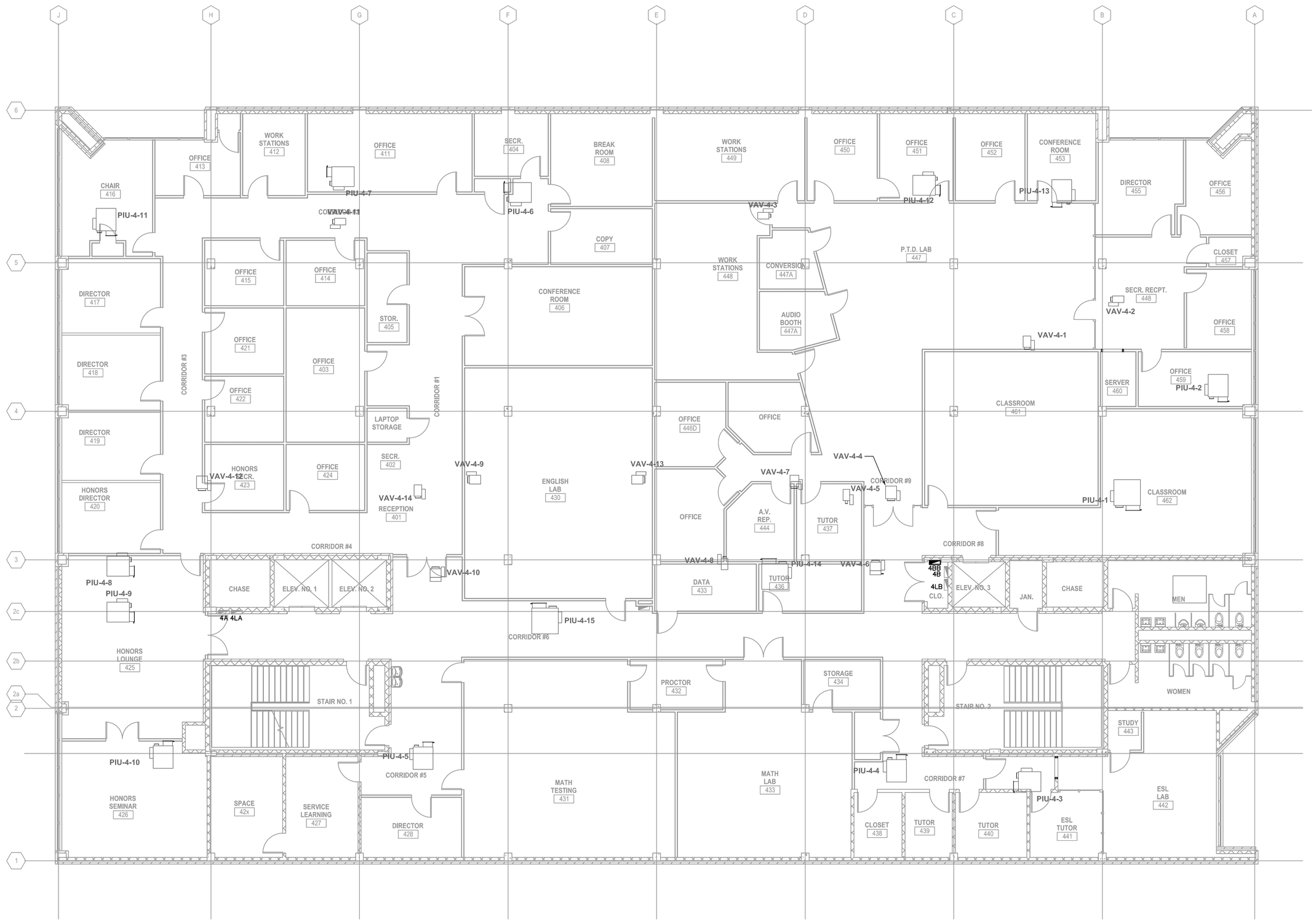
	01/21/15	ADDENDUM 3	

PRINCIPAL IN CHARGE: DPF
PROJECT ARCHITECT:
DRAWN BY: GD

SHEET TITLE:
PROPOSED POWER PLAN - FIRST FLOOR

SHEET NO. E3.1

PROJ. NO. 013328.00



1 E3.4 POWER PROPOSED PLAN - FOURTH FLOOR

1/8" = 1'-0"

GENERAL NOTE

REFER TO SHEET E6.1, MECHANICAL EQUIPMENT SCHEDULE, FOR POWER REQUIREMENTS TO ALL MECHANICAL EQUIPMENT ON THIS SHEET.

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SHEET ISSUE:

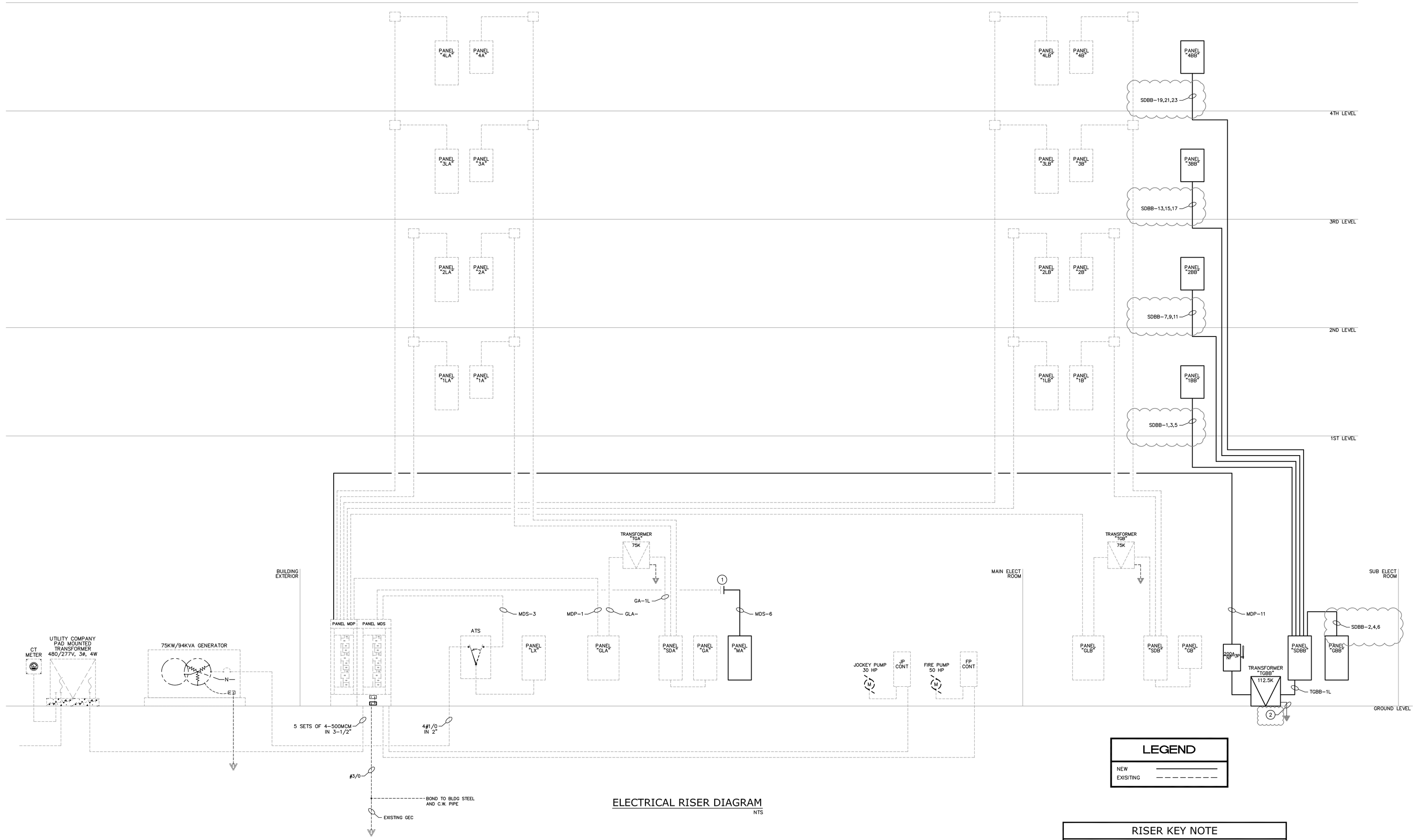
NO.	DATE	DESCRIPTION	BY
	12/04/14	ISSUED FOR BID	
	01/21/15	ADDENDUM 3	

PRINCIPAL IN CHARGE: DPF
PROJECT ARCHITECT: -
DRAWN BY: GD

SHEET TITLE:
POWER PROPOSED PLAN - FOURTH FLOOR

SHEET NO. E3.4

PROJ. NO. 013328.00



ELECTRICAL RISER DIAGRAM

NTS

LEGEND	
NEW	———
EXISITING	– – – – – – –

RISER KEY NOTE

1. INTERCEPT AND EXTEND EXISTING BRANCH FEEDER AS REQUIRED AND CONNECT FOR OPERATION.
2. PROVIDE 1#1/0 GROUNDING ELECTRODE CONDUCTOR IN 3/4" SCHEDULE 40 PVC CONDUIT TO NEAREST EFFECTIVELY GROUNDED BUILDING STRUCTURAL STEEL MEMBER.

SCHEDULE OF DRY-TYPE TRANSFORMER

MARK	KVA	VOLTAGE		MOUNTING	SECONDARY FEEDER			NOTES
		PRIMARY	SECONDARY		MARK	BREAKER	FEEDER	
"TGBB"	112.5	480 VOLT 3ø,3W	208/120 VOLT 3ø,4W	FLOOR	TGBB-1L	(1)	2 SETS OF 4#3/0 & 1#3G IN 2-1/2"	

KEY NOTE:
(1) PANEL MAIN BREAKER IS TRANSFORMER SECONDARY BREAKER.

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	12/04/14	ISSUED FOR BID	
	01/21/15	ADDENDUM 3	

PRINCIPAL IN CHARGE: DPF
PROJECT ARCHITECT: -
DRAWN BY: GD

SHEET TITLE:
ELECTRICAL RISER DIAGRAM

SHEET NO. E5.2

PROJ. NO. 013328.00

SCHEDULE OF BRANCH CIRCUIT PANEL

PANEL SPECIFICATIONS:
SQUARE D "NF" SERIES OR EQUIV.
400 AMP MAIN LUG ONLY
SURFACE MOUNTED

AIC SYMMETRICAL:
18,000

VOLTAGE:
480/277V, 3ø, 4 WIRE

"MA"

WIRE	GROUND	CONDUIT	BREAKER	CIRCUIT	A PHASE KVA	B PHASE KVA	C PHASE KVA	CIRCUIT	BREAKER	CONDUIT	GROUND	WIRE	CIRCUIT DESCRIPTION
3#6	1#10	1"	60	1	–	–		2	20	1/2"	1#12	3#12	RF-2 (RETURN FAN)
				3			–	4					
3#6	1#10	1"	60	5	–	–		6	20	1/2"	1#12	3#12	RF-3 (RETURN FAN)
				7			–	8					
				9	–	–		10					
				11			–	12	3				
3#6	1#10	1"	60	13	–	–		14	–	–	–	–	SPACE
				15			–	16	–	–	–	–	SPACE
				17	–	–		18	–	–	–	–	SPACE
3#3	1#8	1-1/4"	100	19	–	–		20	–	–	–	–	SPACE
				21			–	22	–	–	–	–	SPACE
				23	–	–		24	–	–	–	–	SPACE
4#4	1#8	1-1/4"	80	25	–	–		26	–	–	–	–	SPACE
				27			–	28	–	–	–	–	SPACE
				29	–	–		30	–	–	–	–	SPACE
				31	–	–		32	–	–	–	–	SPACE
				33			–	34	–	–	–	–	SPACE
				35	–	–		36	–	–	–	–	SPACE
				37	–	–		38	–	–	–	–	SPACE
				39			–	40	–	–	–	–	SPACE
				41	–	–		42	–	–	–	–	SPACE
					–	–	–	KVA TOTAL PER PHASE					
					–	–	–	AMPS TOTAL PER PHASE					
					–			KVA TOTAL					

MECHANICAL EQUIPMENT-ELECTRICAL SCHEDULE

EQUIPMENT TAG	BRANCH CIRCUIT	DISCONNECT SWITCH FRAME	DISCONNECT SWITCH FUSE	MOTOR STARTER COMBINATION POLES	MOTOR STARTER COMBINATION NEMA SIZE	NOTES
AHU-0	MA-1,3,5	–	–	–	–	④
AHU-1	MA-7,9,11	–	–	–	–	④
AHU-2	MA-13,15,17	–	–	–	–	④⑤
AHU-3	MA-19,21,23	–	–	–	–	④⑤
AHU-4	MA-25,27,29	–	–	–	–	④
RF-2	MA-2,4,6	–	–	–	–	④⑤
RF-3	MA-8,10,12	–	–	–	–	④⑤
DSS-1	GB-28,30	30	②	2	–	①
PIU-0-1	GLA-*	30	–	1	–	③
PIU-0-2/3	GLB-*	30	–	1	–	③
PIU-1-1/2/3/10/11	1LA-*	30	–	1	–	③
PIU-1-4/5/6/7/8/9	1LB-*	30	–	1	–	③
PIU-2-1/2/3/4/5	2LA-*	30	–	1	–	③
PIU-2-6/7/8/9	2LB-*	30	–	1	–	③
PIU-3-1/2/3/4	3LA-*	30	–	1	–	③
PIU-3-5/6/7/8	3LB-*	30	–	1	–	③
PIU-4-5/6/7/8	4LA-*	30	–	1	–	③
PIU-4-9/10/11/12	4LA-*	30	–	1	–	③
PIU-4-1/2/3/4/12/13	4LB-*	30	–	1	–	③
VAV-0-1/2/3/4/5	GLA-*	30	–	1	–	③
VAV-1-1/2/3/4	1LA-*	30	–	1	–	③
VAV-1-5/6/7	1LB-*	30	–	1	–	③
VAV-2-1/2/3	2LA-*	30	–	1	–	③
VAV-2-4/5/6	2LB-*	30	–	1	–	③
VAV-3-1/2/3	3LA-*	30	–	1	–	③
VAV-3-4/5/6	3LB-*	30	–	1	–	③
VAV-4-9/10/11/12	4LA-*	30	–	1	–	③
VAV-4-1/2/3/4	4LB-*	30	–	1	–	③
VAV-4-5/6/7/8	4LB-*	30	–	1	–	③
MOTORIZED DAMPERS GROUND FLOOR	GA-42	30	–	1	–	③
MOTORIZED DAMPERS GROUND FLOOR	GB-26	30	–	1	–	③
MOTORIZED DAMPERS ROOF	4B-*	30	–	1	–	③

KEY NOTES – NOT ALL NOTES MAY APPLY:

① PROVIDE NEMA 3R ENCLOSURE.

② PROVIDE FUSES AS RECOMMENDED BY EQUIPMENT MANUFACTURER OR NAMEPLATE RATING.

③ PROVIDE MOTOR RATED SWITCH, MOUNT ADJACENT TO UNIT.
* PROVIDE NEW CIRCUIT BREAKER IN PANEL AS INDICATED, INSTALL IN EXISTING SPACE IN PANEL AND CONNECT NEW BRANCH CIRCUIT FOR OPERATION.

④ WIRE BRANCH CIRCUIT THRU FREQUENCY DRIVE (SUPPLIED BY MECHANICAL, INSTALLED BY ELECTRICAL CONTRACTOR).

⑤ PROVIDE WIRING FOR INTERLOCK WITH CORRESPONDING SUPPLY FAN AS REQUIRED, COORDINATE WITH MECHANICAL AND CONNECT FOR OPERATION.

GENERAL MOTORIZED DAMPER NOTE:

MOTORIZED DAMPERS TO BE POWERED VIA ORIGINATING BRANCH CIRCUIT OF FAN, UNLESS NOTED OTHERWISE. REFER TO MANUFACTURER WIRING DETAIL FOR REQUIREMENTS.

BRANCH CIRCUIT PANEL KEY NOTES

1. EXISTING BRANCH CIRCUIT WIRING AND CIRCUIT BREAKER TO REMAIN.
2. PROVIDE NEW BRANCH CIRCUIT WIRING AS INDICATED, CONNECT TO EXISTING SPARE CIRCUIT BREAKER.
3. PROVIDE NEW CIRCUIT BREAKER AS INDICATED, INSTALL IN EXISTING SPACE IN PANEL AND CONNECT NEW BRANCH CIRCUIT FOR OPERATION.
4. REMOVE EXISTING CIRCUIT BREAKER, PROVIDE NEW CIRCUIT BREAKER AND BRANCH CIRCUIT WIRING AS INDICATED AND CONNECT FOR OPERATION.
5. EXISTING BRANCH CIRCUIT WITH LOAD MODIFIED FOR THIS PROJECT.
6. PROVIDE ISOLATED GROUND BAR AND INSTALL IN EXISTING PANEL.
7. EXISTING CIRCUIT BREAKER RELOCATED FROM ANOTHER ELECTRICAL PANEL.
8. REMOVE EXISTING CIRCUIT BREAKER AND BRANCH FEEDER WIRING. PROVIDE NEW CIRCUIT BREAKER AND BRANCH FEEDER WIRING AS INDICATED AND CONNECT FOR OPERATION.
9. PROVIDE CIRCUIT BREAKER WITH LOCK-ON CLIP.
10. PROVIDE CIRCUIT BREAKER WITH GROUND FAULT PROTECTION.
11. REMOVE EXISTING CIRCUIT BREAKER, PROVIDE NEW CIRCUIT BREAKER WITH GFI PROTECTION AND CONNECT TO EXISTING BRANCH WIRING FOR OPERATION.

SCHEDULE OF EXISTING DISTRIBUTION PANEL

PANEL SPECIFICATIONS:
SQUARE D
1600 AMP MAIN LUG ONLY
SURFACE MOUNTED

"MDS"

AIC SYMMETRICAL:
EXISTING

VOLTAGE:
480/277V, 3ø, 4 WIRE

TAG	CIRCUIT DESCRIPTION	FRAME	BREAKER	POLES	FEEDER	A PHASE KVA	B PHASE KVA	C PHASE KVA	NOTES
MDS-1	TRANSFORMER "3C"	–	200	3	–	–	–	–	
MDS-2	JOCKEY PUMP	–	50	3	–	–	–	–	
MDS-3	FIRE PUMP	–	225	3	–	–	–	–	
MDS-4	FIRE PUMP	–	225	3	–	–	–	–	
MDS-5	SPARE	–	400	3	–	–	–	–	
MDS-6	PANEL "MA"	–	400	3	EXISTING	–	–	–	
MDS-7	BREAKER PROVISION	–	–	–	–	–	–	–	
MDS-8	CHILLER	–	500	3	–	–	–	–	
MDS-9	SECTION "MDP"	–	800	3	–	–	–	–	
						–	–	–	KVA TOTAL PER PHASE
						–	–	–	AMPS TOTAL PER PHASE
						–			KVA TOTAL

① EXISTING BRANCH FEEDER AND CIRCUIT BREAKER TO REMAIN.
② EXISTING BRANCH FEEDER WITH LOAD MODIFIED FOR THIS PROJECT.
③ PROVIDE NEW BRANCH CIRCUIT WIRING AND CIRCUIT BREAKER. INSTALL CIRCUIT BREAKER IN SPACE IN PANEL.

SCHEDULE OF EXISTING DISTRIBUTION PANEL

PANEL SPECIFICATIONS:
SQUARE D
800 AMP MAIN LUG ONLY
SURFACE MOUNTED

"MDP"

AIC SYMMETRICAL:
EXISTING

VOLTAGE:
480/277V, 3ø, 4 WIRE

TAG	CIRCUIT DESCRIPTION	FRAME	BREAKER	POLES	FEEDER	A PHASE KVA	B PHASE KVA	C PHASE KVA	NOTES
MDP-1	PANEL "GLA"	–	225	3	EXISTING	–	–	–	
MDP-2	PANEL "GLB"	–	225	3	EXISTING	–	–	–	
MDP-3	PANELS "3LA" & "4LA"	–	100	3	EXISTING	–	–	–	
MDP-4	REFERENCE COMP	–	150	3	EXISTING	–	–	–	
MDP-5	PANELS "1LB" & "2LB"	–	100	3	EXISTING	–	–	–	
MDP-6	PANELS "3LB" & "4LB"	–	100	3	EXISTING	–	–	–	
MDP-7	PANELS "1LA" & "2LA"	–	100	3	EXISTING	–	–	–	
MDP-8	PANEL "GL"	–	100	3	EXISTING	–	–	–	
MDP-9	AT&T	–	125	3	EXISTING	–	–	–	
MDP-10	PANEL "4D"	–	150	3	EXISTING	–	–	–	
MDP-11	PANEL "SBDD" VIA TRANS "TGBB"	–	175	3	3#2/0 & 1#6G IN 2"	–	–	–	
MDP-12	VERIZON	–	100	3	EXISTING	–	–	–	
						–	–	–	KVA TOTAL PER PHASE
						–	–	–	AMPS TOTAL PER PHASE
						–			KVA TOTAL

① EXISTING BRANCH FEEDER AND CIRCUIT BREAKER TO REMAIN.
② EXISTING BRANCH FEEDER WITH LOAD MODIFIED FOR THIS PROJECT.
③ PROVIDE NEW BRANCH CIRCUIT WIRING AND CIRCUIT BREAKER. INSTALL CIRCUIT BREAKER IN SPACE IN PANEL.

SCHEDULE OF BRANCH CIRCUIT PANEL

PANEL SPECIFICATIONS:
SQUARE D "NQ" SERIES OR EQUIV.
400 AMP MAIN CIRCUIT BREAKER
SURFACE MOUNTED

AIC SYMMETRICAL:
10,000

VOLTAGE:
208/120V, 3ø, 4 WIRE

"SDBB"

WIRE	GROUND	CONDUIT	BREAKER	CIRCUIT	A PHASE KVA	B PHASE KVA	C PHASE KVA	CIRCUIT	BREAKER	CONDUIT	GROUND	WIRE	CIRCUIT DESCRIPTION
4#3	1#8	1-1/4"	100	1	–	–		2	100	1-1/4"	1#8	4#3	PANEL "GBB"
				3			–	4					
4#3	1#8	1-1/4"	100	5			–	6	3				
				7	–	–		8	–	–	–	–	SPACE
				9			–	10	–	–	–	–	SPACE
4#3	1#8	1-1/4"	100	11			–	12	–	–	–	–	SPACE
				13	–	–		14	–	–	–	–	SPACE
				15			–	16	–	–	–	–	SPACE
4#3	1#8	1-1/4"	100	17			–	18	–	–	–	–	SPACE
				19	–	–		20	–	–	–	–	SPACE
				21			–	22	–	–	–	–	SPACE
				23			–	24	–	–	–	–	SPACE
				25	–	–		26	–	–	–	–	SPACE
				27			–	28	–	–	–	–	SPACE
				29	–	–		30	–	–	–	–	SPACE
				31			–	32	–	–	–	–	SPACE
				33	–	–		34	–	–	–	–	SPACE
				35			–	36	–	–	–	–	SPACE
				37	–	–		38	–	–	–	–	SPACE
				39			–	40	–	–	–	–	SPACE
				41	–	–		42	–	–	–	–	SPACE
					–	–	–	KVA TOTAL PER PHASE					
					–	–	–	AMPS TOTAL PER PHASE					
					–			KVA TOTAL					

SCHEDULE OF EXISTING BRANCH CIRCUIT PANEL

PANEL SPECIFICATIONS:
SQUARE D
225 AMP MAIN LUGS ONLY
SURFACE MOUNTED

AIC SYMMETRICAL:
EXISTING

VOLTAGE:
208/120V, 3ø, 4 WIRE

"GA"

WIRE	GROUND	CONDUIT	BREAKER	CIRCUIT	A PHASE KVA	B PHASE KVA	C PHASE KVA	CIRCUIT	BREAKER	CONDUIT	GROUND	WIRE	CIRCUIT DESCRIPTION
(2) 2#12	1#12	3/4"	20	1	1.0	0.6		2	20	3/4"	1#12	2#12	RECEPT., WATER COOLER (3)(10)
(2) 2#12	1#12	3/4"	20	3		1.0	0.6	4	20	3/4"	1#12	2#12	RECEPT., VENDING CNTR (3)
(2) 2#12	1#12	3/4"	20	5			1.0	6	20	3/4"	1#12	2#12	RECEPT., VENDING (4)(10)
(2) 2#12	1#12	3/4"	20	7	1.0	1.0		8	20	3/4"	1#12	2#12	RECEPT., VENDING (4)(10)
(2) 2#12	1#12	3/4"	20	9		1.0	1.0	10	20	3/4"	1#12	2#12	RECEPT., VENDING (4)(10)
(2) 2#12	1#12	3/4"	20	11			1.0 –	12	20	–	–	–	SPARE
(2) 2#12	1#12	3/4"	20	13	1.0	–		14	20	–	–	–	SPARE
(2) 2#12	1#12	3/4"	20	15		1.0	–	16	20	–	–	–	SPARE
(2) 2#12	1#12	3/4"	20	17			1.0 1.0	18	20	3/4"	1#12	2#12	RECEPT., INFO COMM (2)
(2) 2#12	1#12	3/4"	20	19	1.0	1.0		20	20	3/4"	1#12	2#12	RECEPT., INFO COMM (2)
(2) 2#12	1#12	3/4"	20	21		1.0	1.0	22	20	3/4"	1#12	2#12	RECEPT., INFO COMM (2)
–	–	–	20	23			– 1.0	24	20	3/4"	1#12	2#12	RECEPT., INFO COMM (2)
–	–	–	20	25	–	1.0		26	20	3/4"	1#12	2#12	RECEPT., INFO COMM (2)
–	–	–	20	27		–	1.0	28	20	3/4"	1#12	2#12	RECEPT., INFO COMM PROJ (2)
–	–	–	20	29			– 1.0	30	20	3/4"	1#12	2#12	RECEPT., INFO COMM PROJ (2)
(2) –	–	–	20	31	–	–		32	20	–	–	–	SPARE
(2) –	–	–	20	33		–	–	34	20	–	–	–	SPARE
(2) –	–	–	20	35			– –	36	20	–	–	–	SPARE
(2) –	–	–	20	37	–	–		38	20	–	–	–	SPARE
(2) –	–	–	20	39		–	–	40	20	–	–	–	SPARE
(2) –	–	–	20	41			– 0.8	42	20	3/4"	1#12	2#12	MOTORIZED DAMPERS
					–	–	–	KVA TOTAL PER PHASE					
					–	–	–	AMPS TOTAL PER PHASE					
					–			KVA TOTAL					

SCHEDULE OF EXISTING BRANCH CIRCUIT PANEL

PANEL SPECIFICATIONS:
SQUARE D
225 AMP MAIN LUGS ONLY
SURFACE MOUNTED

AIC SYMMETRICAL:
EXISTING

VOLTAGE:
208/120V, 3ø, 4 WIRE

"1A"

WIRE	GROUND	CONDUIT	BREAKER	CIRCUIT	A PHASE KVA	B PHASE KVA	C PHASE KVA	CIRCUIT	BREAKER	CONDUIT	GROUND	WIRE	CIRCUIT DESCRIPTION
(2) 2#12	1#12	3/4"	20	1	1.2	0.8		2	20	3/4"	1#12	2#12	RECEPT., STUDY (2)
(2) 2#12	1#12	3/4"	20	3		1.2	1.2	4	20	3/4"	1#12	2#12	RECEPT., STUDY (2)
–	–	–	20	5			– 1.2	6	20	3/4"	1#12	2#12	RECEPT., STUDY (2)
(2) 2#12	1#12	3/4"	20	7	0.6	1.2		8	20	3/4"	1#12	2#12	RECEPT., STUDY (2)
(2) 2#12	1#12	3/4"	20	9		0.6	0.8	10	20	3/4"	1#12	2#12	RECEPT., STUDY (2)
(2) 2#12	1#12	3/4"	20	11			0.8 0.8	12	20	3/4"	1#12	2#12	RECEPT., GROUP STDY (2)
(2) 2#12	1#12	3/4"	20	13	1.2	0.6		14	20	3/4"	1#12	2#12	RECEPT., WATER COOLER (10)
–	–	–	20	15		1.0	–	16	20	–	–	–	SPARE
–	–	–	20	17			1.2 –	18	20	–	–	–	SPARE
(2) 2#12	1#12	3/4"	20	19	1.2	–		20	20	–	–	–	SPARE
(2) 2#12	1#12	3/4"	20	21		1.2	0.6	22	20	–	–	–	SPARE FOR EXISTING (1)
(2) 2#12	1#12	3/4"	20	23			0.6 0.6	24	20	–	–	–	SPARE FOR EXISTING (1)
(2) 2#12	1#12	3/4"	20	25	1.2	0.6		26	20	–	–	–	SPARE FOR EXISTING (1)
(2) 2#12	1#12	3/4"	20	27		0.8	0.6	28	20	–	–	–	SPARE FOR EXISTING (1)
–	–	–	20	29			0.6 0.6	30	20	–	–	–	SPARE FOR EXISTING (1)
					–	–	–	KVA TOTAL PER PHASE					
					–	–	–	AMPS TOTAL PER PHASE					
					–			KVA TOTAL					

SCHEDULE OF EXISTING BRANCH CIRCUIT PANEL

PANEL SPECIFICATIONS:
SQUARE D
225 AMP MAIN LUGS ONLY
SURFACE MOUNTED

AIC SYMMETRICAL:
EXISTING

VOLTAGE:
208/120V, 3ø, 4 WIRE

"GB"

WIRE	GROUND	CONDUIT	BREAKER	CIRCUIT	A PHASE KVA	B PHASE KVA	C PHASE KVA	CIRCUIT	BREAKER	CONDUIT	GROUND	WIRE	CIRCUIT DESCRIPTION
(1) 2#12	1#12	3/4"	20	1	0.8	0.6		2	20	–	–	–	HOT WATER CIRCULATOR (1)
(2) 2#12	1#12	3/4"	20	3		0.4	0.6	4	20	–	–	–	HVAC CONTROL (1)
(2) 2#12	1#12	3/4"	20	5			0.8 0.6	6	20	–	–	–	SPARE FOR EXISTING (1)
(2) 2#12	1#12	3/4"	20	7	0.8	0.6		8	20	–	–	–	SPARE FOR EXISTING (1)
(2) 2#12	1#12	3/4"	20	9		0.8	0.6	10	20	–	–	–	SPARE FOR EXISTING (1)
(2) 2#12	1#12	3/4"	20	11			0.8 0.8	12	20	–	–	–	SPARE FOR EXISTING (1)
(2) 2#12	1#12	3/4"	20	13	0.8	0.6		14	20	–	–	–	SPARE FOR EXISTING (1)
(2) 2#12	1#12	3/4"	20	15		0.8	0.6	16	20	–	–	–	SPARE FOR EXISTING (1)
–	–	–	20	17			– 0.6	18	20	–	–	–	SPARE FOR EXISTING (1)
–	–	–	20	19	–	0.6		20	20	–	–	–	SPARE FOR EXISTING (1)
–	–	–	20	21		–	0.6	22	20	–	–	–	FIRE ALARM (1)
–	–	–	20	23			– –	24	–	–	–	–	SPACE
–	–	–	20	25	–	0.8		26	20	3/4"	1#12	2#12	MOTORIZED DAMPERS
(1) –	–	–	20	27		0.6	0.8	28	20	3/4"	1#10	2#10	DSS-1
(1) –	–	–	20	29			0.6 0.8	30	20	–	–	–	SPACE
					–	–	–	KVA TOTAL PER PHASE					
					–	–	–	AMPS TOTAL PER PHASE					
					–			KVA TOTAL					

SCHEDULE OF BRANCH CIRCUIT PANEL

PANEL SPECIFICATIONS:
SQUARE D "NQ" SERIES OR EQUIV.
100 AMP MAIN LUGS ONLY
SURFACE MOUNTED

AIC SYMMETRICAL:
10,000

VOLTAGE:
208/120V, 3ø, 4 WIRE

"GBB"

WIRE	GROUND	CONDUIT	BREAKER	CIRCUIT	A PHASE KVA	B PHASE KVA	C PHASE KVA	CIRCUIT	BREAKER	CONDUIT	GROUND	WIRE	CIRCUIT DESCRIPTION
–	–	–	–	1	–	–		2	–	–	–	–	RECEPT., INFO COMM
–	–	–	–	3		–	–	4	–	–	–	–	RECEPT., CIRC
–	–	–	–	5			– –	6	–	–	–	–	RECEPT., CIRC
–	–	–	–	7	–	–		8	–	–	–	–	RECEPT., CIRC
–	–	–	–	9		–	–	10	–	–	–	–	RECEPT., ILL
–	–	–	–	11			– –	12	–	–	–	–	RECEPT., ILL
–	–	–	–	13	–	–		14	–	–	–	–	RECEPT., ILL/WRK RM
–	–	–	–	15		–	–	16	–	–	–	–	SPARE
–	–	–	–	17			– –	18	–	–	–	–	SPARE
–	–	–	–	19	–	–		20	–	–	–	–	SPARE
–	–	–	–	21		–	–	22	–	–	–	–	RECEPT., REF CONSULT
–	–	–	–	23			– –	24	–	–	–	–	RECEPT., WRK RM CNTR
–	–	–	–	25	–	–		26	–	–	–	–	RECEPT., RECEIVING CNTR
–	–	–	–	27		–	–	28	–	–	–	–	SPARE
–	–	–	–	29			– –	30	–	–	–	–	SPARE
–	–	–	–	31	–	–		32	–	–	–	–	SPARE
–	–	–	–	33		–	–	34	–	–	–	–	SPARE
–	–	–	–	35			– –	36	–	–	–	–	RECEPT., IDF RM
–	–	–	–	37	–	–		38	–	–	–	–	RECEPT., IDF RM
–	–	–	–	39		–	–	40	–	–	–	–	RECEPT., IDF RM
–	–	–	–	41			– –	42	–	–	–	–	RECEPT., IDF RM
					–	–	–	KVA TOTAL PER PHASE					
					–	–	–	AMPS TOTAL PER PHASE					
					–			KVA TOTAL					

SCHEDULE OF EXISTING BRANCH CIRCUIT PANEL

PANEL SPECIFICATIONS:
SQUARE D
225 AMP MAIN LUGS ONLY
SURFACE MOUNTED

AIC SYMMETRICAL:
EXISTING

VOLTAGE:
208/120V, 3ø, 4 WIRE

"1B"

WIRE	GROUND	CONDUIT	BREAKER	CIRCUIT	A PHASE KVA	B PHASE KVA	C PHASE KVA	CIRCUIT	BREAKER	CONDUIT	GROUND	WIRE	CIRCUIT DESCRIPTION
2#12	1#12	3/4"	20	1	1.0	1.2		2	20	3/4"	1#12	2#12	RECEPT., ASST DEAN/WRK RM
2#12	1#12	3/4"	20	3		1.0	1.0	4	20	3/4"	1#12	2#12	RECEPT., ASST DEAN/WRK RM
–	–	–	20	5			– 0.8	6	20	3/4"	1#12	2#12	RECEPT., WAIT/OFFICE
2#12	1#12	3/4"	20	7	0.6	0.8		8	20	3/4"	1#12	2#12	RECEPT., COPIER
2#12	1#12	3/4"	20	9		0.6	0.6	10	20	3/4"	1#12	2#12	RECEPT., BIB INSTRUCT
2#12	1#12	3/4"	20	11			0.6 0.6	12	20	3/4"	1#12	2#12	RECEPT., BIB INSTRUCT
2#12	1#12	3/4"	20	13	1.2	1.0		14	20	3/4"	1#12	2#12	RECEPT., BIB INSTRUCT PROJ
2#12	1#12	3/4"	20	15		1.0	1.0	16	20	3/4"	1#12	2#12	RECEPT., BIB INSTRUCT PROJ
2#12	1#12	3/4"	20	17			0.8 0.8	18	20	3/4"	1#12	2#12	RECEPT., BIB INSTRUCT
2#12	1#12	3/4"	20	19	1.2	0.6		20	20	3/4"	1#12	2#12	RECEPT., BIB INSTRUCT
2#12	1#12	3/4"	20	21		1.2	1.0	22	20	3/4"	1#12	2#12	RECEPT., BRK RM
–	–	–	20	23			– 0.4	24	20	3/4"	1#12	2#12	RECEPT., BRK RM CNTR
–	–	–	20	25	–	0.4		26	20	3/4"	1#12	2#12	RECEPT., BRK RM CNTR
2#12	1#12	3/4"	20	27		1.2	0.8	28	20	3/4"	1#12	2#12	RECEPT., BRK RM REF
2#12	1#12	3/4"	20	29			1.0 1.0	30	20	3/4"	1#12	2#12	RECEPT., BR
–	–	–	20	31	–	0.6		32	20	3/4"	1#12	2#12	RECEPT., WATER COOLER (11)
–	–	–	20	33		–	–	34	20	–	–	–	SPARE
–	–	–	20	35			– –	36	20	–	–	–	SPARE
–	–	–	20	37	–	–		38	20	–	–	–	SPARE
–	–	–	20	39		–	–	40	20	–	–	–	SPARE
–	–	–	20	41			– –	42	20	–	–	–	SPARE
					–	–	–	KVA TOTAL PER PHASE					
					–	–	–	AMPS TOTAL PER PHASE					
					–			KVA TOTAL					

SCHEDULE OF BRANCH CIRCUIT PANEL

PANEL SPECIFICATIONS:
SQUARE D "NQ" SERIES OR EQUIV.
100 AMP MAIN LUGS ONLY
SURFACE MOUNTED

AIC SYMMETRICAL:
10,000

VOLTAGE:
208/120V, 3ø, 4 WIRE

"1BB"

WIRE	GROUND	CONDUIT	BREAKER	CIRCUIT	A PHASE KVA	B PHASE KVA	C PHASE KVA	CIRCUIT	BREAKER	CONDUIT	GROUND	WIRE	CIRCUIT DESCRIPTION
–	–	–	–	1	–	–		2	–	–	–	–	SPARE
–	–	–	–	3		–	–	4	–	–	–	–	SPARE
–	–	–	–	5			– –	6	–	–	–	–	SPARE
–	–	–	–	7	–	–		8	–	–	–	–	SPARE
–	–	–	–	9		–	–	10	–	–	–	–	SPARE
–	–	–	–	11			– –	12	–	–	–	–	SPARE
–	–	–	–	13	–	–		14	–	–	–	–	SPARE
–	–	–	–	15		–	–	16	–	–	–	–	SPARE
–	–	–	–	17			– –	18	–	–	–	–	SPARE
–	–	–	–	19	–	–		20	–	–	–	–	SPARE
–	–	–	–	21		–	–	22	–	–	–	–	SPARE
–	–	–	–	23			– –	24	–	–	–	–	SPARE
–	–	–	–	25	–	–		26	–	–	–	–	SPARE
–	–	–	–	27		–	–	28	–	–	–	–	SPARE
–	–	–	–	29			– –	30	–	–	–	–	SPARE
					–	–	–	KVA TOTAL PER PHASE					
					–	–	–	AMPS TOTAL PER PHASE					
					–			KVA TOTAL					

SCHEDULE OF BRANCH CIRCUIT PANEL

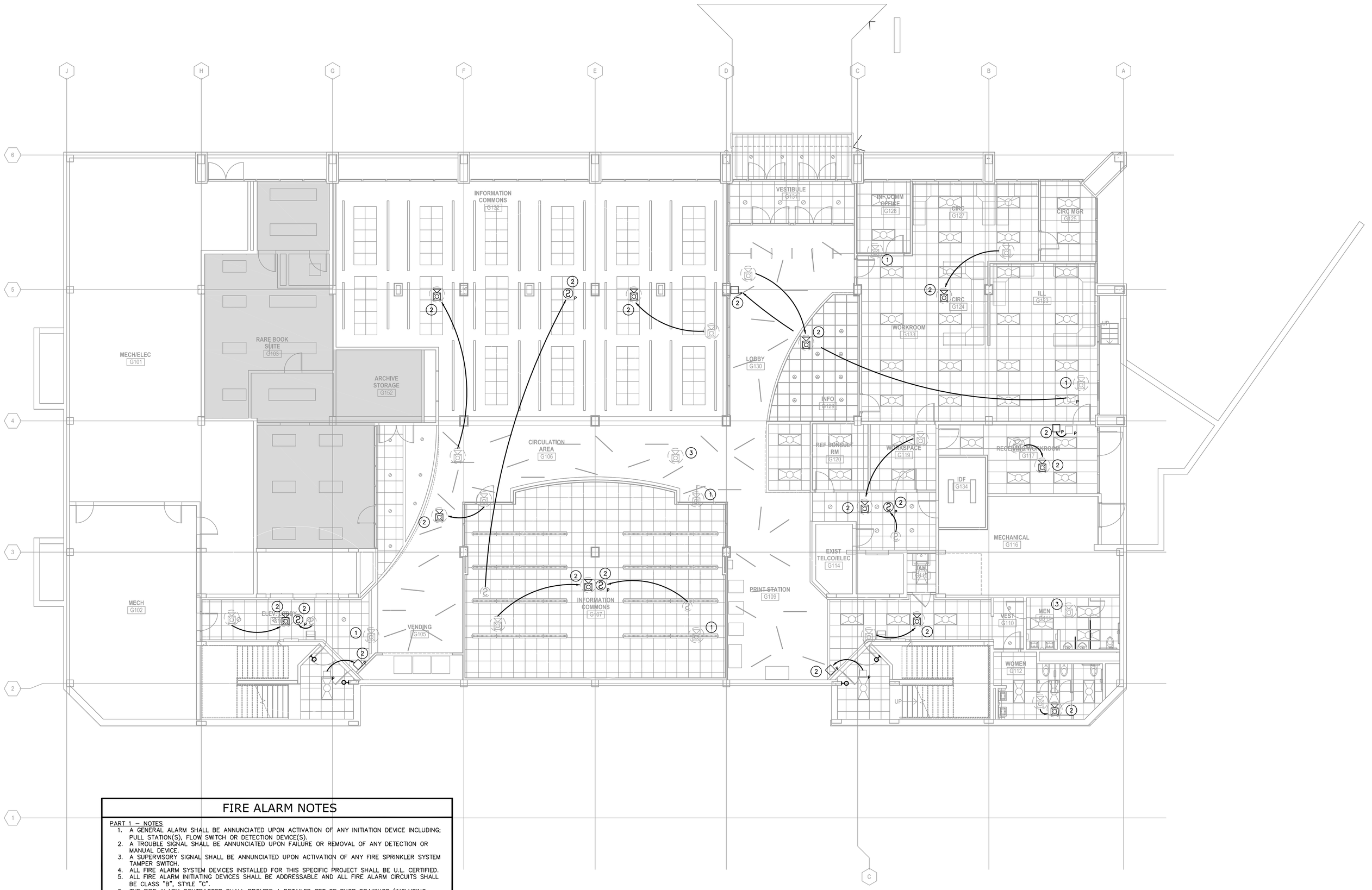
PANEL SPECIFICATIONS:
SQUARE D "NQ" SERIES OR EQUIV.
100 AMP MAIN LUGS ONLY
SURFACE MOUNTED

AIC SYMMETRICAL:
10,000

VOLTAGE:
208/120V, 3ø, 4 WIRE

"2/3/4BB"

WIRE	GROUND	CONDUIT	BREAKER	CIRCUIT	A PHASE KVA	B PHASE KVA	C PHASE KVA	CIRCUIT	BREAKER	CONDUIT	GROUND	WIRE	CIRCUIT DESCRIPTION
–	–	–	–	1	–	–		2	–	–	–	–	SPARE
–	–	–	–	3		–	–	4	–	–	–	–	SPARE
–	–	–	–	5			– –	6	–	–	–	–	SPARE
–	–	–	–	7	–	–		8	–	–	–	–	SPARE
–	–	–	–	9		–	–	10	–	–	–	–	SPARE
–	–	–	–	11			– –	12	–	–	–	–	SPARE
–	–	–	–	13	–	–		14	–	–	–	–	SPARE
–	–	–	–	15		–	–	16	–	–	–	–	SPARE
–	–	–	–	17			– –	18	–	–	–	–	SPARE
–	–	–	–	19	–	–		20	–	–	–	–	SPARE
–	–	–	–	21		–	–	22



FIRE ALARM NOTES

PART 1 – NOTES

1. A GENERAL ALARM SHALL BE ANNUNCIATED UPON ACTIVATION OF ANY INITIATION DEVICE INCLUDING; PULL STATION(S), FLOW SWITCH OR DETECTION DEVICE(S).
2. A TROUBLE SIGNAL SHALL BE ANNUNCIATED UPON FAILURE OR REMOVAL OF ANY DETECTION OR MANUAL DEVICE.
3. A SUPERVISORY SIGNAL SHALL BE ANNUNCIATED UPON ACTIVATION OF ANY FIRE SPRINKLER SYSTEM TAMPER SWITCH.
4. ALL FIRE ALARM SYSTEM DEVICES INSTALLED FOR THIS SPECIFIC PROJECT SHALL BE U.L. CERTIFIED.
5. ALL FIRE ALARM INITIATING DEVICES SHALL BE ADDRESSABLE AND ALL FIRE ALARM CIRCUITS SHALL BE CLASS "B", STYLE "C".
6. THE FIRE ALARM CONTRACTOR SHALL PROVIDE A DETAILED SET OF SHOP DRAWINGS (INCLUDING DEVICE CUT SHEETS), A COMPLETE POINT TO POINT WIRING DIAGRAM, FLOOR PLAN DRAWINGS INDICATING ALL DEVICE LOCATIONS AND NUMBERS, COMPLETE BATTERY CALCULATIONS AND COMPLETE NOTIFICATION APPLIANCE CIRCUIT CALCULATIONS (FOR THE SYSTEM TO BE INSTALLED) TO THE BUILDING DEPARTMENT (AUTHORITY HAVING JURISDICTION) AT THE TIME OF APPLICATION FOR BUILDING PERMIT.
7. PROVIDE THE OWNER WITH A COMPLETE FIRE ALARM SYSTEM AND INSTALLATION MANUAL, COVERING ALL SYSTEM EQUIPMENT INSTALLED FOR THIS PROJECT. KEEP AT THE MAIN FIRE ALARM CONTROL PANEL.
8. PROVIDE CERTIFICATE OF COMPLETION AT THE FINAL INSPECTION OF THE FIRE ALARM SYSTEM
9. ALL WORK SHALL BE PERFORMED IN ACCORDANCE WITH THE CURRENT EDITIONS OF NFPA 72 AND NATIONAL ELECTRICAL CODE.

PART 2 – EQUIPMENT

1. ALL NEW EQUIPMENT AND DEVICES SHALL BE U.L. LISTED FOR FIRE SERVICE AND SHALL BE COMPATIBLE WITH THE EXISTING SYSTEM IN USE.
2. THE FIRE ALARM SHALL BE CAPABLE OF FUTURE EXPANSION AS REQUIRED.
3. ROUTING OF THE FIRE ALARM SYSTEM CONDUIT IS DIAGRAMMATIC ONLY, VERIFY EXACT LOCATIONS PRIOR TO STARTING WORK.
4. ALL FIRE ALARM NOTIFICATION APPLIANCES SHALL ACTIVATE UPON INITIATION OF THE GENERAL ALARM.
5. ALL FIRE ALARM AUDIBLE SIGNALS IN OPEN AREA SHALL HAVE A THREE PLUS TEMPORAL PATTERN.
6. ALL FIRE ALARM AUDIBLE SIGNALS SHALL HAVE A SOUND LEVEL OF AT LEAST 15 dba ABOVE THE AVERAGE AMBIENT SOUND LEVEL.
7. MANUAL STATIONS TO BE INSTALLED AT 48" INCHES A.F.F.
8. MOUNT FIRE ALARM SYSTEM AUDIBLE/VISUAL SIGNALS (COMBINATION DEVICES) SUCH THAT THE ENTIRE STROBE LENS IS 80" A.F.F. OR 6" BELOW CEILING, WHICHEVER IS LOWER.
9. MOUNT FIRE ALARM SYSTEM STROBES SUCH THAT THE ENTIRE STROBE LENS IS 80" A.F.F. OR 6" BELOW CEILING, WHICH EVER IS LOWER.
10. SMOKE DETECTORS TO BE INSTALLED AS REQUIRED BY NFPA 72.
11. MOUNT FIRE ALARM MINI HORNS AT 80" A.F.F. OR 6" BELOW CEILING, WHICHEVER IS LOWER.
12. THE FIRE ALARM PANEL MUST HAVE AN EARTH GROUND CONNECTION AS REQUIRED BY THE SYSTEM MANUFACTURER, AND N.E.C. ARTICLE 760. MINIMUM WIRE SIZE IS #8 AWG FOR GROUND CONNECTION. (NOTE PANEL NEUTRAL OR CONDUIT GROUND IS NOT ACCEPTABLE).
13. HVAC DUCT SMOKE DETECTORS SHALL BE CONNECTED TO THE FIRE ALARM CONTROL PANEL AND SHALL INITIATE A SUPERVISORY SIGNAL ONLY.

PART 3 – WIRING

1. ALL WIRING AND CONDUIT TO CONFORM TO NFPA 72 AND NEC ARTICLE 760. WIRING SHALL BE SOLID COPPER OR STRANDED COPPER WITH A MAX. OF 7 STRANDS FOR 16 GA AND 18 GA, STRANDED COPPER WITH A MAXIMUM OF 19 STRANDS FOR SIZES 14 AND LARGER PER NEC 760 AND NFPA 70.
2. COLOR CODING MAY NOT APPLY TO EXISTING SYSTEMS, LABEL EXISTING WIRING ACCORDINGLY.

PART 4 – FIRE PROTECTION

1. ALL FIRE STOP PENETRATIONS SHALL BE MADE WITH APPROVED (NEC) METALLIC CONDUIT AND SHALL BE SEALED WITH A U.L. APPROVED FIRE STOP MATERIAL.

KEY NOTES

1. EXISTING FIRE ALARM DEVICE TO BE REMOVED. NO LONGER REQUIRED DUE TO RENOVATION.
2. EXISTING FIRE ALARM DEVICE TO BE RELOCATED AS INDICATED DUE TO RENOVATION.
3. EXISTING FIRE ALARM DEVICE TO REMAIN.

FIRE ALARM PROPOSED PLAN - GROUND FLOOR

1/8" = 1'-0"

FIRE ALARM SHEET INDEX

FA3.0	FIRE ALARM NOTES AND PROPOSED PLAN–GROUND FLOOR
FA3.1	FIRE ALARM PROPOSED PLAN–FIRST FLOOR

FIRE ALARM LEGEND

- FIRE ALARM MANUAL PULL STATION EXISTING
- PHOTOELECTRIC SMOKE DETECTOR EXISTING
- FIRE ALARM HORN / STROBE COMBINATION, CEILING MOUNTED EXISTING
- FIRE ALARM MAGNETIC DOOR HOLDER, WALL MOUNTED (FLOOR MOUNT IN LOCATIONS AS REQUIRED) MATCH BUILDING STANDARD

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SEAL

GEORGIA REGISTERED PROFESSIONAL ENGINEER SCOTT MERIWETHER

STURGIS LIBRARY RENOVATIONS

Kennesaw State University
Kennesaw, Georgia 30144

SHEET ISSUE:

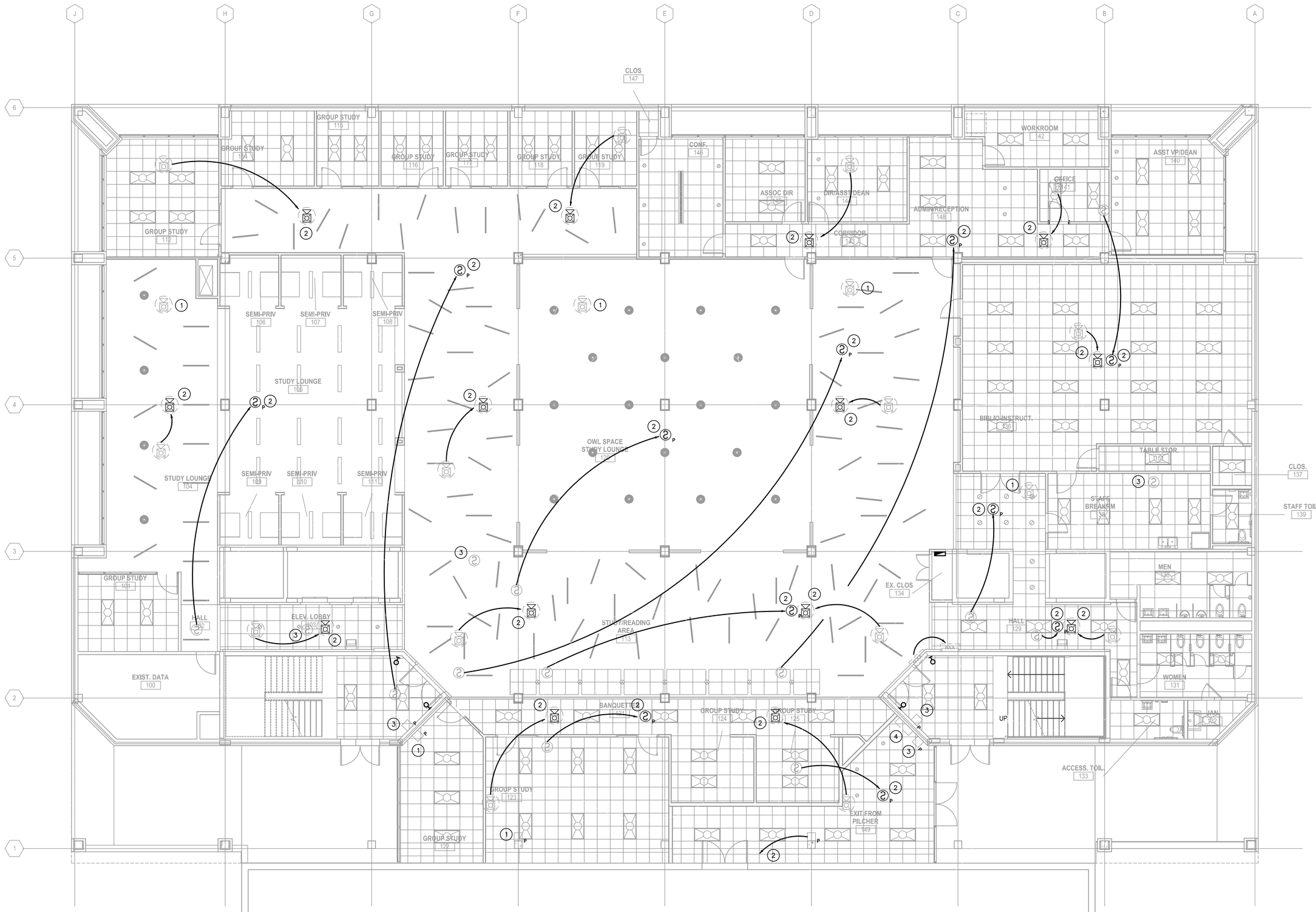
NO.	DATE	DESCRIPTION	BY
	12/04/14	ISSUED FOR BID	
	01/21/15	ADDENDUM 3	

PRINCIPAL IN CHARGE: DPF
PROJECT ARCHITECT:
DRAWN BY: GD

SHEET TITLE:
FIRE ALARM NOTES AND PROPOSED PLAN - GROUND FLOOR

SHEET NO. FA3.0
ADDED SHEET

PROJ. NO. 013328.00



1 / FA3.1 PROPOSED FIRE ALARM PLAN - FIRST FLOOR

1/8" = 1'-0"

KEY NOTES

1. EXISTING FIRE ALARM DEVICE TO BE REMOVED. NO LONGER REQUIRED DUE TO RENOVATION.
2. EXISTING FIRE ALARM DEVICE TO BE RELOCATED AS INDICATED DUE TO RENOVATION.
3. EXISTING FIRE ALARM DEVICE TO REMAIN.
4. LOCATION OF EXISTING FIRE COMMAND PANEL.

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SEALS

STURGIS LIBRARY RENOVATIONS

Kennesaw State University
Kennesaw, Georgia 30144

SHEET ISSUE:

NO.	DATE	DESCRIPTION	BY
	12/04/14	ISSUED FOR BID	
	01/21/15	ADDENDUM 3	

PRINCIPAL IN CHARGE: DPF
PROJECT ARCHITECT:
DRAWN BY: GD

SHEET TITLE:
PROPOSED FIRE ALARM PLAN - FIRST FLOOR

SHEET NO. FA3.1 ADDED SHEET

PROJ. NO. 013328.00